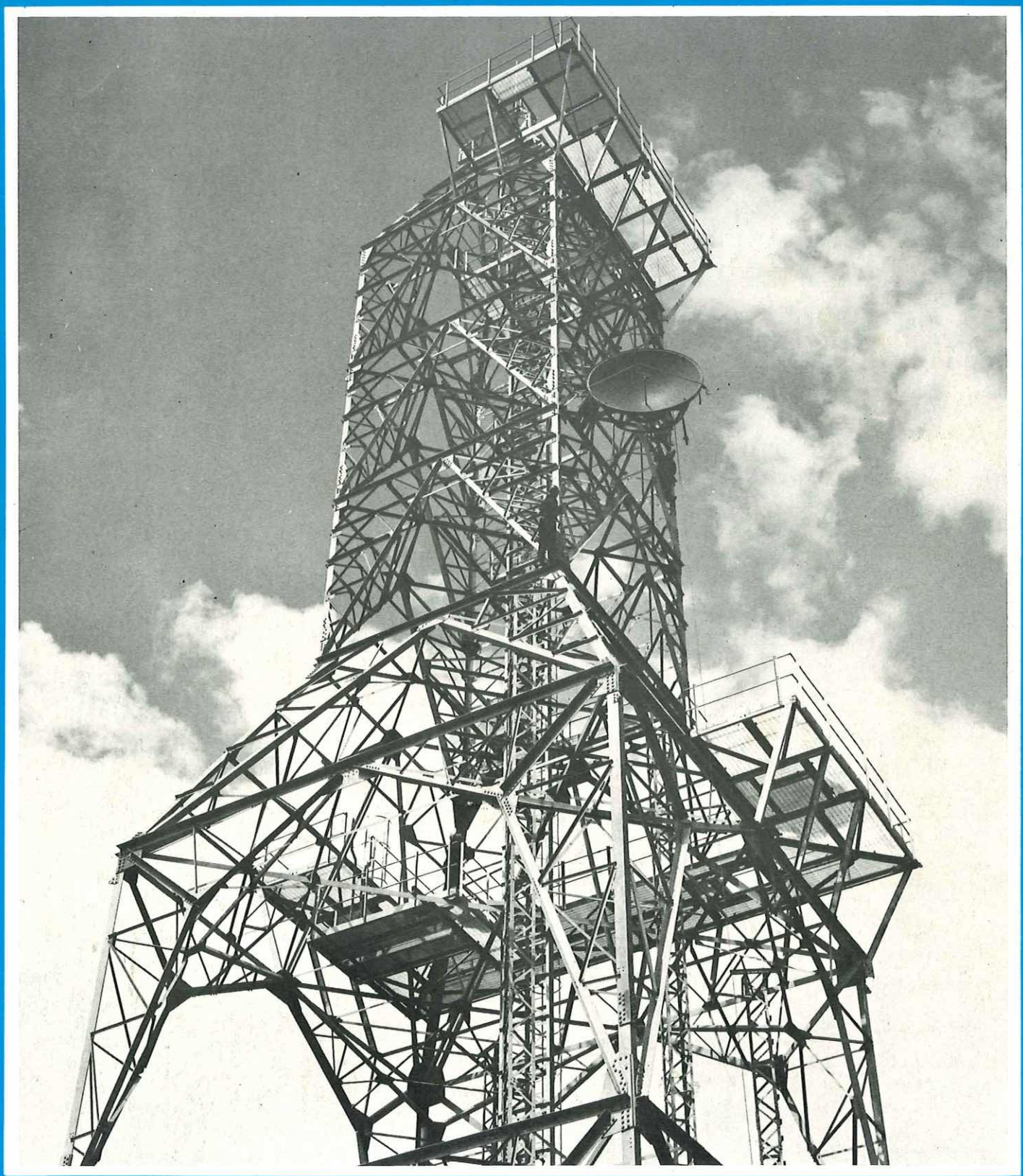
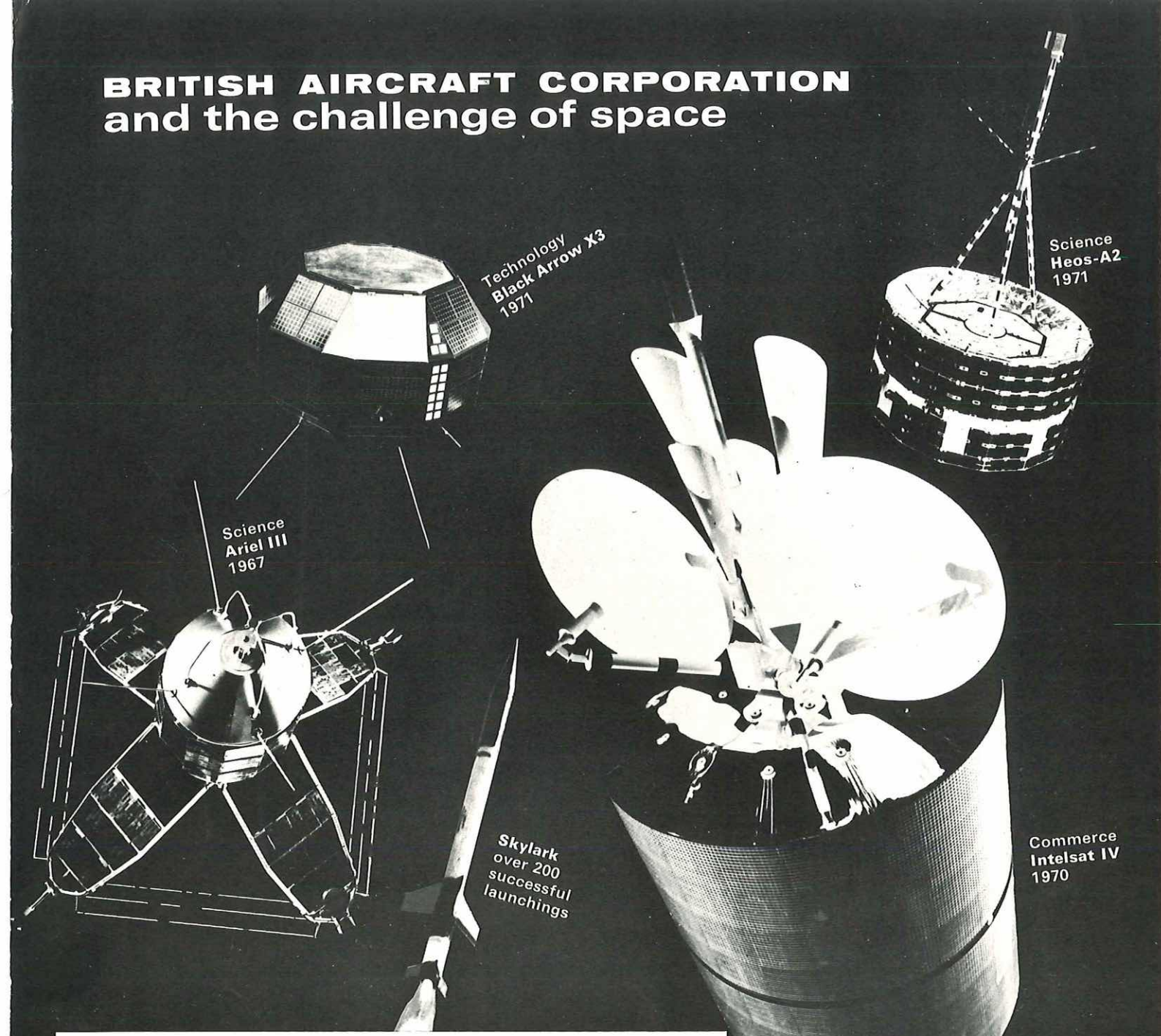
Post Office telecommunications journal

One shilling and sixpence

Winter 1969 Vol. 21. No. 4



BRITISH AIRCRAFT CORPORATION
and the challenge of space



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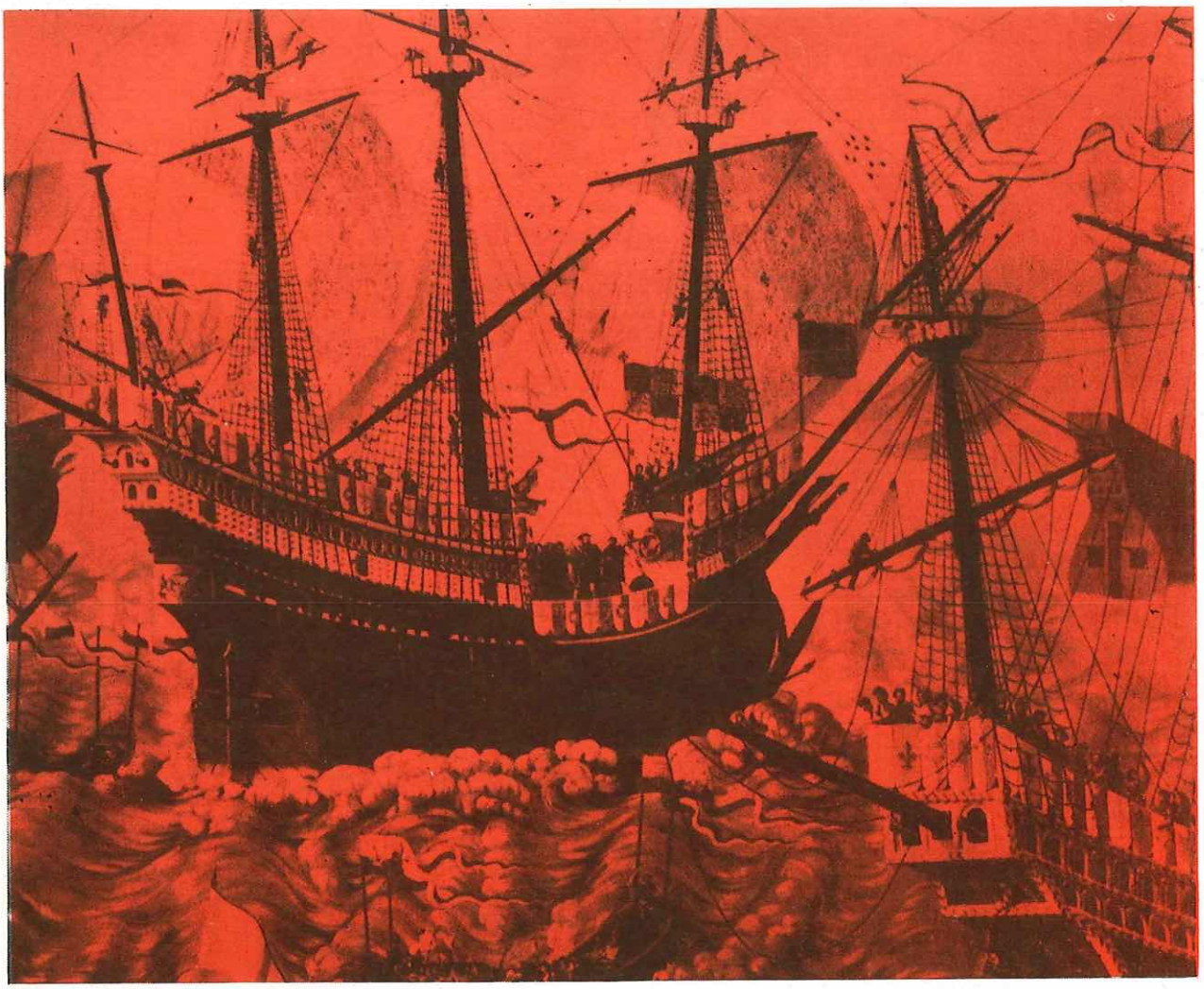

Even in Vasco da Gama's time they knew how long a cable was*

Vasco da Gama managed the 6,000 miles from Lisbon to the Cape in a nippy four months, way back in 1497.
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*1/10 of a nautical mile if you are in any doubt.

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And so STC can look forward perhaps to being loved by lovers internationally.

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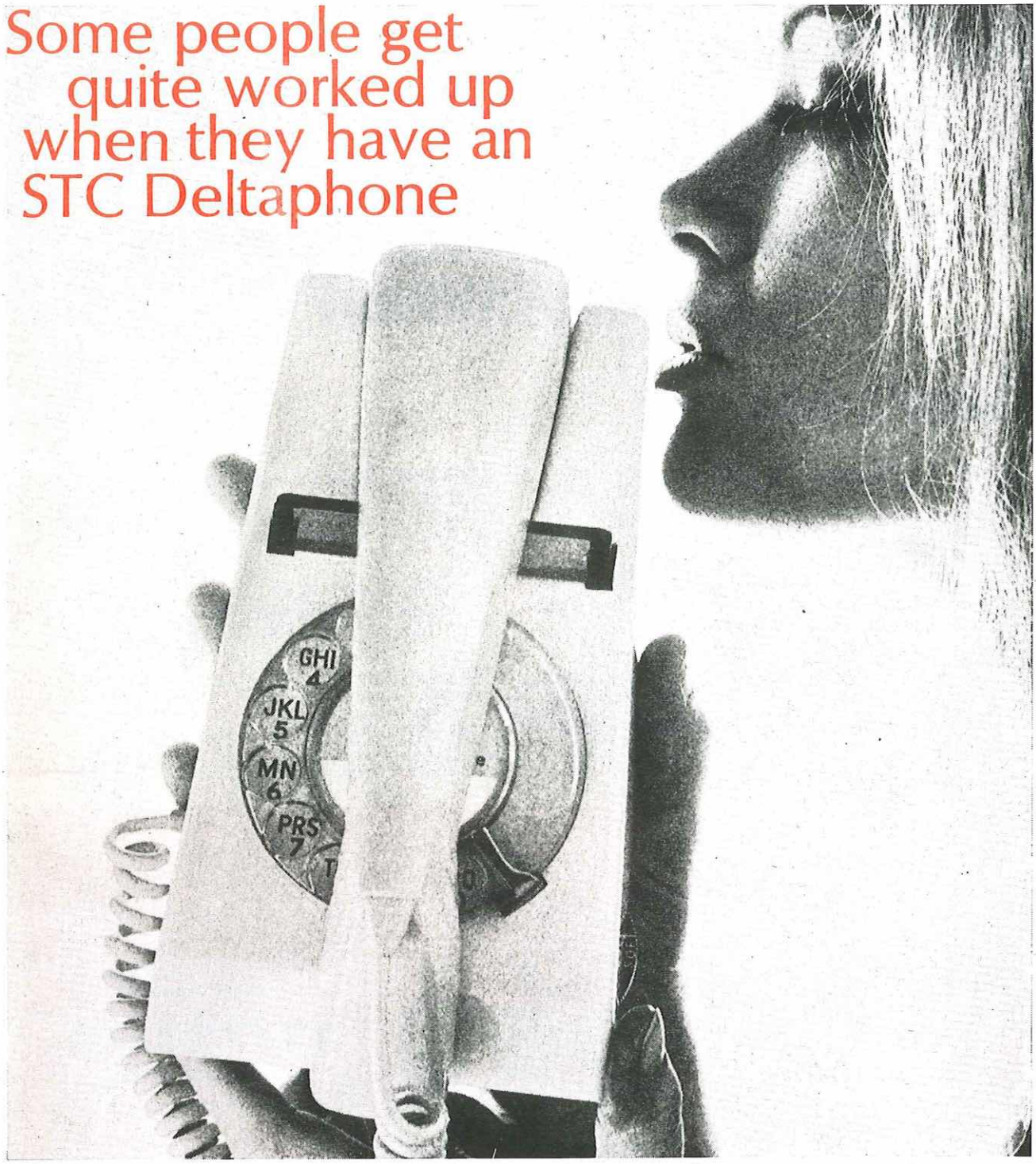
Some people get quite worked up when they have an STC Deltaphone



STC's Deltaphone is pretty exciting, after all.
And it does things other telephones don't.
For instance, it can glow in the dark. There's an optional luminescent dial which lets you dial without turning lights on.
And nobody gets disturbed when the Deltaphone rings. Mainly because it doesn't ring. It just *warbles* – at the volume you set.
In fact, the Deltaphone is very sociable. People like it because it's slim – at 4·3 inches it's only a fraction wider than the dial.
And the 4-ounce handset is only half the weight of a conventional one. So it's twice as nice to hold.
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69/2D

The Dash Mounted Westminster has created a lot of talk

(the reasons are simple)

This front mounted solid-state radiotelephone operates in the VHF band from 25–174 MHz. Both AM and FM versions are available.

The transmitter power output of the series ranges from 5–15 watts (AM 5–8 watts; FM 12–15 watts) with 1–10 channels. Various other features include anti-flutter squelch, and an illuminated channel indicator.

The units have been designed as a 'family' and much of the circuitary is common to both base stations and mobiles.

The equipment meets all relevant specifications, including P.O. specification W6770, and is in use in many P.O. radiotelephone systems throughout the U.K. Rugged all-weatherproof universal versions are also available.

The W30AM

The W30AM is an extension of the Westminster range and being one of the most powerful VHF radiotelephones available in this country it will overcome problems of reception from vehicles in weak signal areas. 10-channel capability with solid-state switching.

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Deac manufacture button cells and their batteries and import Varta cells for distribution and for battery construction

Post Office telecommunications journal

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

Vol. 21 Winter 1969 No. 4

All-figure Numbers Now

THE introduction of all-figure telephone numbers in six major cities is now in its final stages. Conversion of telephone directories and dialling instructions to show all-figure numbers in London, Birmingham, Manchester, Liverpool, Glasgow and Edinburgh is virtually complete. The plan to make this change was first publicised in 1965, but people still ask why it had to be made; some still regret the passing of the old familiar exchange names and the need to adjust dialling habits.

These doubts and questions may swell again now that the next step in the plan is being taken—the gradual withdrawal of the temporary arrangement in which calls are connected whether people dial mixed letters and figures or the new all-figure numbers. The withdrawal of this facility begins in London in January, so it is perhaps the right time to recall the compelling reasons for the change to all-figure numbering.

One major reason arises from the growth of the telephone system which is expected to double within the next ten years, and already new or replacement telephone exchanges are being opened throughout the country at the rate of up to ten a month. In the six big cities each exchange needs separate identification, and the use of letters in a meaningful or pronounceable form (MAYfair, VIKing) is limited to 320 codes. The use of figures gives a great increase in the number of available codes. If all-figure numbering had not been introduced, London would already have used up all available letter codes and essential expansion of the service would have been frustrated.

The growth of international dialling provides another reason for the change. It is estimated that by the end of this century about 600 million people throughout the world will be able to dial to other countries. However, full advantage of these facilities cannot be taken unless all national numbering schemes are on the same basis, and Britain was one of the few countries to have mixed letters and figures on its dials.

All-figure numbering also makes it possible to move some of the space-consuming trunk switching centres away from congested and expensive sites in the middle of the big cities. In London there are ten switching centres within one mile of Charing Cross handling two million trunk calls a day, a figure that will increase to six million by 1980. Switching centres moved to the outskirts of London, each serving a group of exchanges in a geographical sector, will be better placed to handle calls to and from customers outside the central area. This decentralisation can be achieved only if calls dialled from any part of the country—or the world—are routed direct to the correct switching centre. To achieve this the early digits of each exchange code must be exclusive to one sector, and for this reason it was not always possible to make the new all-figure numbers the exact equivalent of the letters on the dial. However, the Post Office worked out the sectors and the conversions to make as many numbers as possible correspond to the old letter form.

Most customers have taken all-figure numbering in their stride, and service measurements of the calls made to all-figure codes show an encouraging response. However, the withdrawal of the dual-access facility, in which calls could get through even if the letter codes are used, will provide a new test. Some of the equipment used for this facility is urgently needed for growth, but the withdrawal will be gradual, and customers will have the maximum time to get used to the system. The letter codes will be withdrawn in London from January in batches of about six a month, and callers to these exchanges using the old letter code will hear a recorded announcement for three months. After that, for about nine months, they will be connected to the number unobtainable tone. In the other cities the old codes will be withdrawn gradually from April.

Every effort is being made to keep the customer fully informed about these changes. In the past three years millions of explanatory leaflets and letters have been distributed. During the coming months the Post Office will make extensive use of publicity, and will send each customer a personal notice shortly before his letter code is discontinued.

In the long run the change to all-figure numbering will mean that the system will be able to deal with all possible expansion and demand up to the end of the century. It also provides a foundation for further expansion in the next century.

IN THIS ISSUE

COVER PICTURE: Post Office riggers are being kept busy by the spread of three-channel colour television over the whole country. They are erecting dish aerials for the TV colour signals that go over microwave circuits. See "More Colour Television".

THE BACKGROUND

Changing to

BRITAIN is going metric for a number of compelling reasons. Firstly, it will bring us in line with the majority of the world's population, some 90 per cent of which lives in countries already committed to the metric system. Secondly, the change will considerably improve our export potential and will prevent wasteful duplication by firms who presently manufacture in both imperial and metric units. Finally, there are the many advantages stemming from the inherent simplicity of the system with its reduced liability to error and untold savings of time spent in calculation.

Surprisingly, an early attempt to standardise on metric weights and measures in Britain was made as long ago as 1897 but was defeated because the bulk of our exports then went to countries who used imperial units of measurement.

By the early 1960s the position had changed dramatically and surveys of industrial opinion revealed a clear majority in favour of the change. In 1965, following representations from the Federation of British Industry, the Government announced its support for the switchover and expressed the hope that it would be substantially completed in ten years. The British Standards Institution was given the task of preparing the essential metric standards and a committee representative of Industry and Government was set up to assist and review progress. It was this Committee's report, published in 1968, that led the Government to clarify its policy by indicating 1975 as the target date for the adoption of metric weights and measures by the country *as a whole.* It also resulted in the establishment, in 1969, of the Metrication Board with its responsibility for overall co-ordination of the exercise.

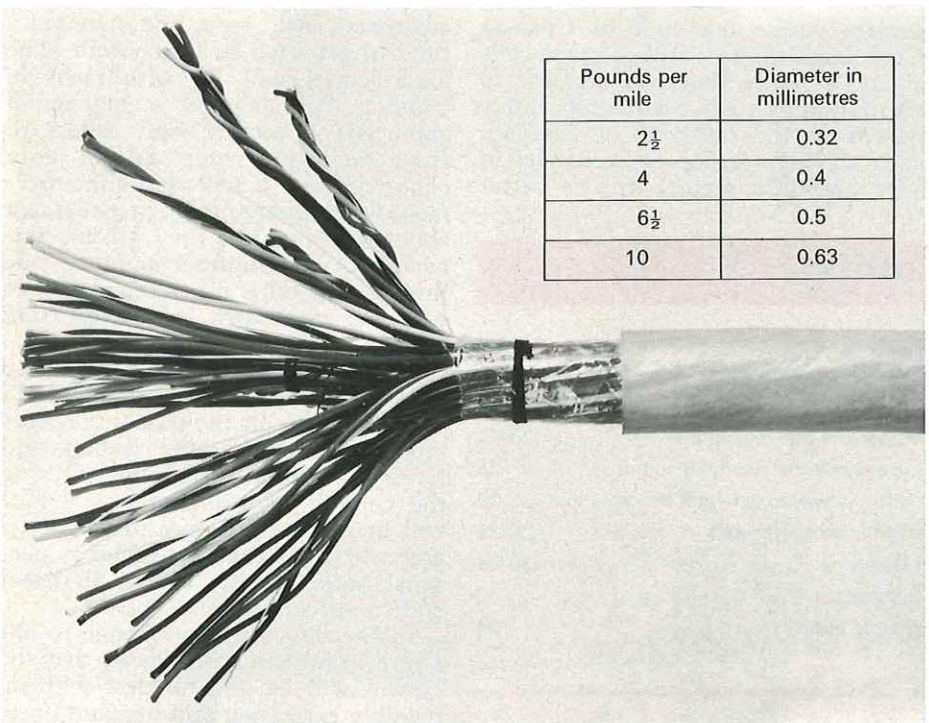
The use of metric weights and measures in much of the public and domestic sector will have to wait for the passage of enabling legislation since imperial units are used in many Acts of Parliament. Examples are those concerned with road speed regulations and others governing the sale of certain foodstuffs. It is also considered that the public should be given the opportunity to become familiar with decimal currency before being asked to accept unfamiliar units for mass, length, etc.

Metrication in the industrial field however has been making steady progress under the general guidance of the BSI. Programs for the change have been published for four industrial sectors—the construction, engineering, electrical and marine industries. These programs take the form of charts and allocate periods of time for the various activities leading to the eventual production of metric items. These activities include the preparation of metric standards for the basic materials, tools and components, the production of materials and tools to the new standards, their acquisition by stockists and finally their use in the manufacture of items designed in metric terms.

The preparation of the basic standards is a most important step. It is at this stage that it is possible to harmonise British standard specifications with those agreed internationally or used by metric countries. Account can be taken of preferred numbers to standardise on sizes which bear a sensible geometric relation to one another and there are excellent opportunities for rationalisation and variety reduction. Some 1,400 basic metric standards should be available by the end of 1970.

In going metric at this time Britain is able to take advantage of the development by the competent international body—the CGPM—of a system of units known simply as SI. Already more than 30 countries have said that they will make it the only legally accepted system. Briefly, SI is based on traditional metric units, such as the metre and kilogram, and it is in fact an extension of the MKSA system already well known in electrotechnology. Only six basic units are used to derive compound units suitable for use in all technologies. Each unit may be associated with a number of prefixes to create decimal multiples and submultiples. Hence the metre—with the kilometre (1,000 m), millimetre (0·001 m), etc.—is used for all measurements of length. In due course it will replace the mile, furlong, chain, rod, pole, perch, yard, foot, inch, of our present system.

The great merit of SI is that it is both rational and coherent. It is rational because only **one** unit is used to express a quantity regardless of its form. In the case of energy for example the SI unit, the joule, is used to express electrical, mechanical and heat energy and so this unit replaces the kilowatt hour, the horsepower



Pounds per mile	Diameter in millimetres
$2\frac{1}{2}$	0.32
4	0.4
$6\frac{1}{2}$	0.5
10	0.63

Under the metric system the present method of describing a conductor by its weight in pounds per mile is replaced by a simple statement of its diameter in millimetres. The table shows the metric equivalents.

hour, the calorie, the therm and many more. The system is coherent because units for derived quantities are all obtained by combining the basic units without the addition of any numerical factors. By combining the unit for length with that for time one obtains the unit for velocity, the metre per second. The unit for acceleration —which is rate of change of velocity —becomes the metre per second squared. By Newton's second law, force is proportional to mass times acceleration and so its unit becomes the kilogram metre per second squared. Appropriately enough this unit has been named the newton (symbol N) and its introduction is one of the major innovations of SI.

OUR PLANS

POST Office involvement in metrication has been gradual and it was not until the end of 1968 that it was thought desirable to establish a small group in Telecommunications HQ to provide internal co-ordination and external liaison with the BSI, Metrication Board and other authorities.

Within the business, the exercise is under the overall control of a Steering Committee chaired by the head of Power, Civil and Mechanical Engineering Division of Telecommunications Development Department. Working parties have been set up to deal with specific projects and a Joint Post Office—Telecommunications Engineering and Manufacturing Association Metrication Steering Group serves as a forum for discussion with industry.

Post Office policy towards metrication reflects the Government's intention that Departments and public authorities shall foster and assist the change. It is recognised, however, that each sector of industry must determine its own timetable and the Post Office, in the role of customer, is dependant on the progress its suppliers can achieve.

The manufacturers of electric cables were one of the first groups to fix a target—1 January 1970—for the production of metric items. Following discussions with the Post Office, the telephone cable makers decided that they would change to metric production in their factories during the mid-summer holidays in 1970. For its part the Post Office agreed that it would rewrite its specifications in metric terms in time for the due date.

Clearly, this exercise must not result in the production of metric cables having transmission parameters differing significantly from those of the imperial versions they replace. It therefore becomes mainly a matter of dimensional conversion with some rounding up or down. However, the conductor sizes have been aligned with international wire sizes where possible and SI units have been used throughout. The traditional way of describing a conductor by its weight in pounds per mile has been replaced by a simple statement of its diameter in millimetres—a practice already adopted for aluminium conductors.

Implicit in the Post Office's acceptance of the cable industry's plans was the need to use metric units in all transactions with the cable makers on and from an agreed date. This in turn indicated the desirability of using these units in internal documentation and in most other activities directly connected with cables. Accordingly, it was decided in 1968 that the cable exercise would serve as a general introduction to metric working in the Post Office. This means that metric units will be used in the field for planning and construction and on all

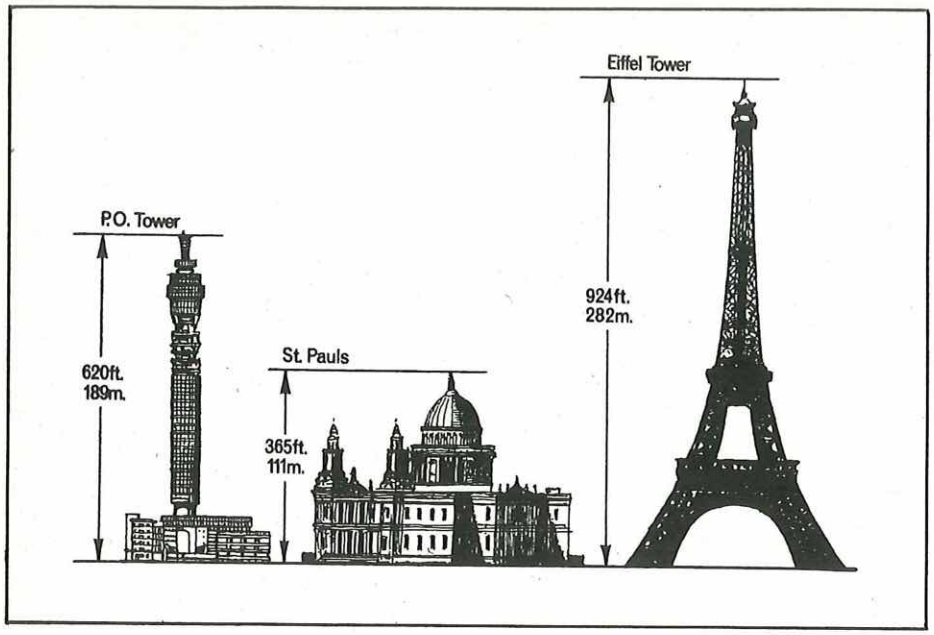
metric

By S. J. ARIES

The new telephone kiosk is a completely metric design. The dimensions of the customer are also given.

THE AUTHOR

Mr. S. J. Aries *was appointed Assistant Staff Engineer to lead the Standards and Metrication Group in Telecommunications Development Department. Formed just over a year ago, the Group is co-ordinating the introduction of Metrication in the Post Office and maintains contacts with other outside bodies.*



plans, diagrams and other documents, such as the stores rate book, which deal with cable. The implications of the decision are far reaching and a working party has the task of examining them and co-ordinating the issue of implementing instructions by the various Departments involved.

Some instructions have already been issued and metric measuring equipment and conversion tables have been made available. Planning of a number of cable schemes in metric terms will begin in January, 1970, and it is proposed to convert the description of all cable assets into metric units on the following 23 March. A dual version of Section 2WC of the Stores Rate Book will be published and Stores Tally Cards will be metricated. Thereafter, the computer controlling cable stores will use the metre as its unit of issue. Many related activities—such as the metrication of cable drums, poles, ducts, manholes, etc.—are taking place but it is too soon to report on them in detail.

The timetable for metrication adopted by the construction industry called for metric design to begin in 1969. The program was endorsed by the Ministry of Works and the Post Office is already receiving plans for metric buildings. Accommodation standards have been discussed with the Staff Side and instructions have been issued to the field. Metric buildings need not differ significantly from those designed in imperial terms and it should not be difficult to install imperial equipment in a metric building or vice versa.

The new telephone kiosk (see *Telecommunications Journal* Autumn, 1968) is a completely metric design although it has to accommodate the existing wallboards and cash compartments. Fortunately the tolerance in the fixing holes in these items permits the use of metric bolts at centres spaced by a whole number of millimetres. The design is thus suitable for the eventual introduction of metric fittings.

The design and production of new equipment to metric standards is a comparatively straightforward procedure. It is in connection with the maintenance and continued production of well established imperial designs that the real problems are likely to arise. The Post Office has a vast amount of Strowger-type switching equipment in use and is planning to augment it by some £400 million during the next few years. It would obviously be grossly uneconomic to carry out a complete redesign of this equipment in metric terms. As the changeover gathers pace, however, metric materials and components will increasingly displace their imperial counterparts and price differentials will be established. There will therefore be mounting pressure on manufacturers to make wholesale changes throughout their factories.

Some of the Post Office's contractors have already sought our reactions to the use of metric fasteners in Strowger-type equipment. This subject was considered by the main Steering Committee and it was decided that metric fasteners, materials and components could be introduced subject to adequate safeguards. The way in which this decision can be implemented and the procedures designed to ensure satisfactory performance, mechanical interchangeability, suitable identification, etc., are being worked out with industry.

The Research Department is in a fortunate position as far as metrication is concerned since it is responsible for the design and production of experimental models and prototype equipment. As a result good progress has been made and a metric workshop has been set up at Dollis Hill. An article describing metric developments in Research Department will be published in a forthcoming issue of the Journal.

There is still a long way to go in our metric conversion. Experience so far, however, suggests that more difficulties are anticipated than actually occur in practice and the change may well be easier than expected.

Metrication is explained in a new pamphlet "The Change to Metric" produced by Engineering Training Branch. It tells why the change is being made and the advantages it will bring. A summary is given of SI units with examples of how the change will affect staff both at work and at home. The booklet also deals with Decimalisation and details the changes in currency and their application in the Post Office. Copies can be obtained through local Training Officers.

BY ROYAL COMMAND

THE Duke of Edinburgh opened a "Royal Command" telecommunications exhibition at the Design Centre, London, in November. The exhibition, which was put on at the suggestion of Prince Philip, illustrated the development of Post Office services.

Prince Philip said at the opening ceremony that he had put forward the suggestion for the exhibition because the impact of telecommunications on the community was probably greater than any other service. Efficient telecommunications was vital to the business and social communities.

"It is very encouraging to find that the Post Office has taken such a lot of trouble to produce sensible designs," said Prince Philip. He hoped that those involved in design would continue to see that equipment was aesthetically pleasing.

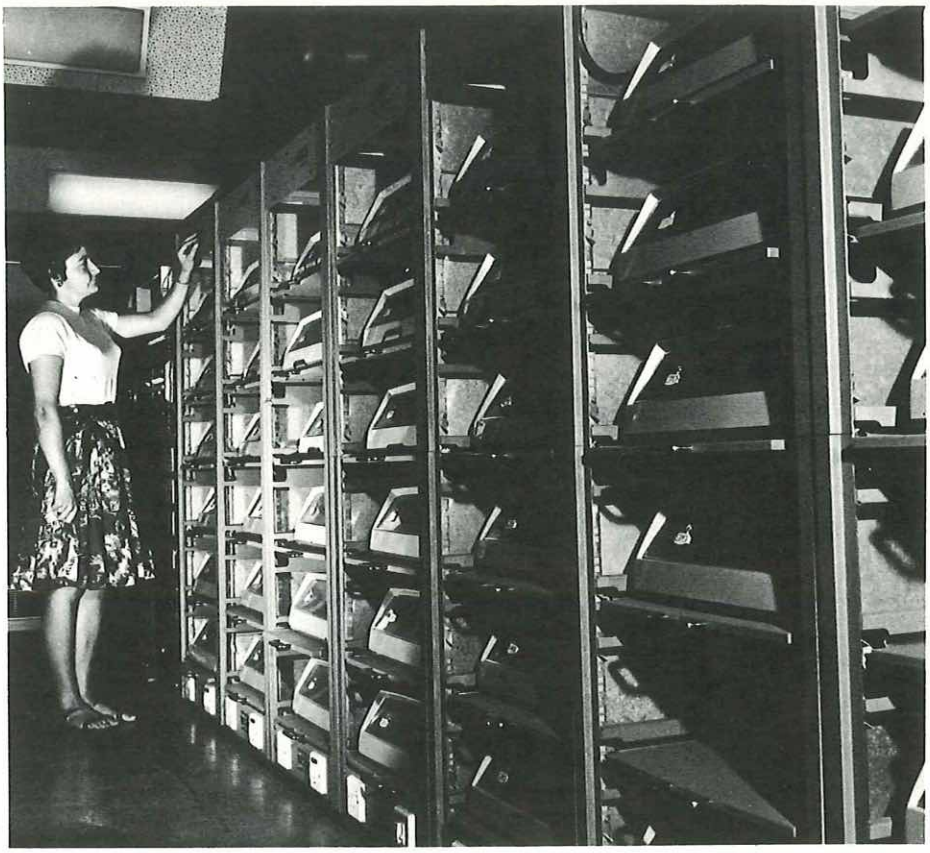
The exhibition included room settings showing typical offices of 1909, 1970 and 1990. The "office of the future" display showed a civil engineer working from his HOME, able to make use of telex, facsimile transmission and visual communication without leaving his favourite armchair. The display predicted that the engineer will use a viewphone to communicate drawings or components, and an ordinary telephone for everyday calls. (Not completely ordinary because this telephone is cordless and uses microwaves so that it can be carried around his room.) It was suggested that a visual display unit, with a large screen, can be connected to a library of microfilmed drawings. A light pen can be used for anything from correcting proofs to altering technical drawings and these amendments are fed to a computer which automatically produces fresh data and drawings. The facsimile reproduction unit can reproduce drawings and written information from a number of sources while a teleprinter provides written communication.

More firmly based on fact was the 1970 display which included a loudspeaking telephone, callmaker equipment for automatic dialling, a small private automatic exchange, telex—and the trimphone which won a Design Centre award in 1966.

The exhibition, which also described developments in switching and transmission techniques, was jointly organised by the Post Office and the Council of Industrial Design. It was open for a month.

● *See picture page 30.*

DATA



This computer bureau uses Datel 200 and offers time-sharing facilities for firms who want problems solved by computer. A number of modems No. 2 are rack mounted.

B-O-O-M!

During the last few years there has been a huge increase in the demand for the Post Office Datel services which enable digital data for computers to be transmitted over telephone and telegraph lines. Now comes a report which indicates that the growth in demand has only just begun.

Data transmission is a new art and has its own vocabulary. The following definitions may be useful:

MODEM—A modulator/demodulator device linking the Post Office transmission lines to a computer or to Data Terminal Equipment. The modem converts data signals into forms suitable for transmission over Post Office circuits and provides a check on accuracy of transmission. A modem usually forms the interface between the data transmission services and data processing or terminal equipment.

DATA TERMINAL—The terminal point of one or more Post Office circuits used for the transmission of data and linked by interface with data transmit, receive or processing equipment. A single data terminal may thus be of any size from a complete Computer Service Bureau down to a single data collection or print out point.

DATA TERMINAL EQUIPMENT—Apparatus on the user side of the modem for transmitting or receiving data.

TRANSMISSION SPEEDS—measured in bits (binary digits).

Fast: above 10,000 bits per second.
Medium: 201 bps to 10 Kbps.
Slow: 200 bps and below.

DATA transmission is on the threshold of explosive expansion. Even against the present rapid expansion of demand for Datel services, the potential for growth for the 1980s is phenomenal.

This view of the prospects for data transmission services is confirmed in a report submitted to the Post Office by Scicon, an independent consultancy. They were commissioned to carry out the most comprehensive market survey of the country's data transmission needs ever undertaken. The report follows eight months of intensive work by a specialist team who interviewed representatives of commerce and industry and other large-scale users of Datel services. The team sought to establish how the present services are used; to forecast the total demand for facilities over the next five, ten and fifteen years; and to assess what types of facility users are likely to need.

Nearly 6,000 data terminals are operating in Britain today, compared with under 3,000 a year ago. The consultants estimate that by 1973 there will be 51,000 terminal points in operation, by 1978 about 234,000 and by 1983 about 434,000.

However, Scicon stress that forecasts so far ahead must contain a margin of error, and this was expected at the outset. The combination of the newness of the technology, its wide variety of applications, the relatively small number of users and the very rapid growth rate make it very difficult to project current experience in a specific and precise way. Nevertheless, Scicon used three separate forecasting methods to produce their final estimates, and these all indicated huge increases in growth.

The purposes for which data transmission is used were of obvious importance as a basis for estimating the pace of growth. The study classified the main motivations for use as:

- Reduced costs arising from sharing a large computer facility, particularly where individual utilisation is low or variable.
- Convenience and advantages of swift job turnround.
- Facilitating "real time" computer operations where immediate access to, and response from, the computer is vital to the success of the operation (e.g. air-line seat reservation systems).
- Facilitating more efficient management control systems.

The last category is illustrated by the case of one organisation that reduced its number of warehouses from 27 to three, while maintaining the same marketing capability, by using data transmission facilities for rapid control of production stock holding relative to sales.

A significant point emerging from the studies of present and foreseeable future applications of data transmission was that very few applications would involve the use of fast transmission (above 10,000 bits a second) and these will not give rise to the need for many terminal points in relation to the total demand.

Another finding is that the majority of new applications will not be much more complex than systems which are currently operational or under

COMPUTERS will soon be dialling their own calls in Britain with the aid of a new data control unit built to Post Office specifications. It will be the first time in Britain that data has been transmitted over the public telephone network entirely without human intervention. Unattended answering by remote data terminals is already possible, but at present these calls have to be initiated manually.

A business using the new control units will be able to "tell" its computer to make a series of calls at a predetermined time, either to send or collect data. A typical use could be to gather details of the previous day's sales figures from a chain of branch stores. This could be done during cheap-rate periods at night or at weekends, or using the new Midnight Line facility which allows unlimited calls between midnight and 6 a.m. for a fixed annual charge.

Similarly, figures on stock held at various points could be gathered overnight to speed up re-stocking. Instructions could be sent automatically either by telephone or Telex to distant offices for attention first thing next morning.

The new control units were first shown publicly in a Post Office demonstration at Datafair '69, held at Manchester University. There were also live demonstrations, made over the public telephone network.

This and other Post Office displays at Datafair '69 showed the enormous resources of the Post Office which are available to cater for customers' telecommunications needs, with particular emphasis on data transmission. One display, on the growth of Post Office Datel services, introduced new modems for use on the 48 kilobit switched Datel network planned to link London, Birmingham and Manchester. These modems can also be used on private "group band" circuits.

Visitors also saw a Datel test centre in action, similar to eight already in use to test Datel equipment by remote control. A programme of lectures was presented daily covering data transmission policy, an outline of the U.K. telecommunications network, the fundamentals of digital communication, existing and future Datel services and various aspects of planning, installation and maintenance of customers' data transmission networks.

development—so that the potentiality for growth of applications exists now. The report says that information retrieval and data banks have been much publicised and have large potential growth. The next 15 years will see a great increase in the storage of data by direct access devices with on-line access for up-dating and enquiry.

Within a few years, says the Scicon report, an increasing number of graduates will be entering commerce and industry with experience, or at least awareness, of the potential uses of data transmission. These graduates will later exert an influence on policy matters, and Scicon expects that this will eventually have an overall effect on the growth rate.

There has been much speculation about the need for a "Computer Grid" providing for very high speed transmission in the range of 250 Kbps to 1.5 Mbps. The Scicon study concludes that there is unlikely to be a need for such a grid, in the sense of a switched "public" network, within the next five years, though there may well be demand for direct links at such speeds between computers. However, evidence pointed to a need for a computer grid providing for speeds up to about 10 Kbps, and that this would meet the requirements of nearly all potential users for at least five and, perhaps, ten years.

The report comments that a very encouraging feature of the situation in this country is that the Post Office controls the nationwide telecommunications services, unlike the position in the United States. The Post Office is in a position to co-ordinate and draw on all possible existing services for data transmission and Scicon add that the Post Office "could place the UK in a unique and favourable position in data transmission which would enhance our use of computing equipment and set an international lead in this important and prestige activity".

The Scicon study, and three technical studies on data network techniques now being carried out for the Post Office, form the first part of a three-stage assessment of data transmission needs into the 1980s. Using these studies in the second stage, the Post Office will develop a fully costed plan for future data transmission services so that a scale of charges can be drawn up. The third stage will be a market survey to assess the demand for specific services.

TOP: An operator at the Redland tile manufacturer's head office prepares data for transmission over the Datel 200 service. Orders received at the head office are sent on to the firm's quarries.

BOTTOM: In the computer room of the National Provincial Bank headquarters data is received and transmitted over the Datel 600 network. Details of customers' accounts are among the items handled.

Harry Secombe joins the campaign

A number of important advertising campaigns using newspapers, television and posters began in the autumn. Why does the Post Office, with its monopoly in telecommunications, need to advertise to sell its wares? What are the aims of current advertising?

Comedian Harry Secombe in costume for one of the television commercials in the off-peak campaign. This is his first TV commercial—he agreed to take part because it was for a public service industry.

TELECOMMUNICATIONS advertising—as with all methods of publicity—fulfils two main functions. First, to communicate information about the various services to existing and potential customers; second, to play its part in carrying out marketing objectives—to draw in profitable business. This latter function will become increasingly important as the telecommunications business is able to sell its equipment and services on an ever increasing scale as a result of the huge capital investment programme.

The strongest promotional campaign undertaken since the October, 1968, tariff changes has been advertising to stimulate telephone calling during cheap-rate periods—"*It's so cheap to phone your friends after six and at weekends*". This campaign is directed at the residential market with the object of increasing revenue —an additional profit of at least £1m. is the aim in this financial year—and persuading customers to make greater use of the STD exchange equipment and line plant during periods when it would otherwise be lying idle.

The 1969-70 campaign began in September with a short burst of national press advertising to introduce the "*It's so cheap . . .*" slogan which is appearing on posters throughout the country. This is an extension of the previous year's successful poster campaign, again using a straightforward message and simple design.

The posters are being used to support a powerful series of television commercials featuring top entertainment personalities—Harry Secombe, Irene Handl and Ronnie Barker—in a number of humorous situations on the theme of the cheap-rate message. One of the Harry Secombe versions (he made three in all, his first excursion into the commercial field) was shot in colour and transmitted on the first night of Independent Television's colour service.

The cheap-rate campaign is just one of the current major advertising promotions. Another deals with the problem of conversion to **all-figure numbers.** Customers have been aware for some time that the three-letter, four-figure combinations used in London and the five larger provincial centres have had to be converted to all-figure telephone numbers. By making special tee-ing arrangements on those exchanges where the all-figure number is not equivalent to the old letter/figure combination it has been possible for people dialling, say, ACO xxxx to be connected to 992 xxxx.

From January, 1970, these tees will be progressively cut, and for a time people trying to dial the old letter combination will be connected to a recorded announcement. In order

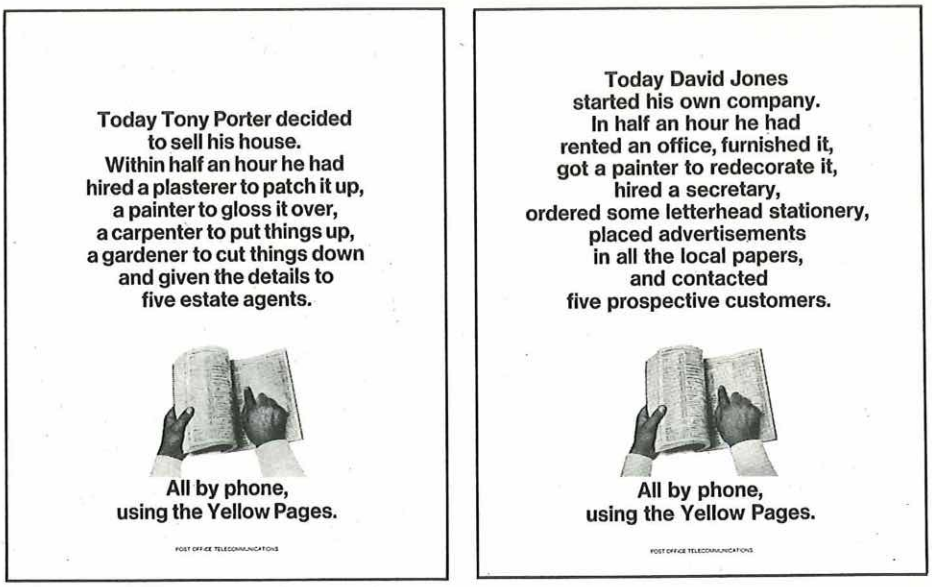
to give full publicity to this final stage of the change, press advertising and posters are being used to draw attention to the need for dialling only all-figure numbers, and supplement the notice included in the latest issue of the London Dialling Code Booklet. Additionally, a postcard message will be despatched to all subscribers on a tee-d exchange just prior to the tee being cut. Customers are being reminded to ensure that the all-figure telephone number appears on their stationery, vehicles and advertising.

During the current financial year national coverage will be achieved by the new **Yellow Pages directories** and the advertising emphasis has therefore been modified. Formerly, publicity for the Yellow Pages directories has been confined to concentrated campaigns in those telephone areas where the directories were introduced for the first time, and has taken two forms; firstly, to increase customer awareness of the new format and to encourage use of the classified services included in the Yellow Page section; secondly, to encourage business subscribers to buy advertising space.

The revenue from the latter type of campaign offsets the high cost of telephone directory production and this form of advertising is the responsibility of the Thomson Organisation, which holds the contract for producing the Yellow Page listings. The "usage" advertising has been commissioned by the Post Office. This type of concentrated campaign informed the customer about the new-style directory launched in his area, and promoted telephone shopping.

With the achievement of national coverage by the directories, the emphasis of the advertising has been switched to the "user" type of campaign by both Thomsons and the Post Office, using mainly national media, including television.

The All-figure Numbers Now campaign.



The Yellow Pages campaign.

To help achieve a planned growth target of 18 per cent in the very profitable **telex** service, new advertising campaigns were prepared. One, in the national "business" newspapers, covers the broad range of potential customers, and centres attention on the general attractions of telex communication. The other, in specialist publications, is directed at specific markets—solicitors, public libraries and ambulance services—where there is a great potential for improving communications facilities.

In a specialist campaign of this nature the sales force should be able to pinpoint most of its likely customers, and this is helped by inviting telephone replies to advertisements. These campaigns are thus devised to support the field selling operations.

In December, as in previous years, there were two national press campaigns about **Christmas and New Year** services. The earlier one reminded subscribers that advance booking for overseas Christmas calls (and Continental calls where they cannot be dialled direct) would avoid possible disappointment; the later one announced the withdrawal of inland cheap rate operator-controlled calls in order that as many operating staff as possible could have their Christmas at home (similar advertisements are appearing in the Scottish press for the New Year holiday period).

Other press advertising campaigns are under consideration to stimulate sales of datel services, trimphones, telephone extensions and small business systems. Whether or not these advertisements are used will depend largely upon such factors as levels of unstimulated demand, equipment deliveries, opportunities for collaborating in specialist press features and supplements, etc.

These are the major advertising projects during the latter half of the current financial year. There will also be localised campaigns to introduce STD conversions and information services.

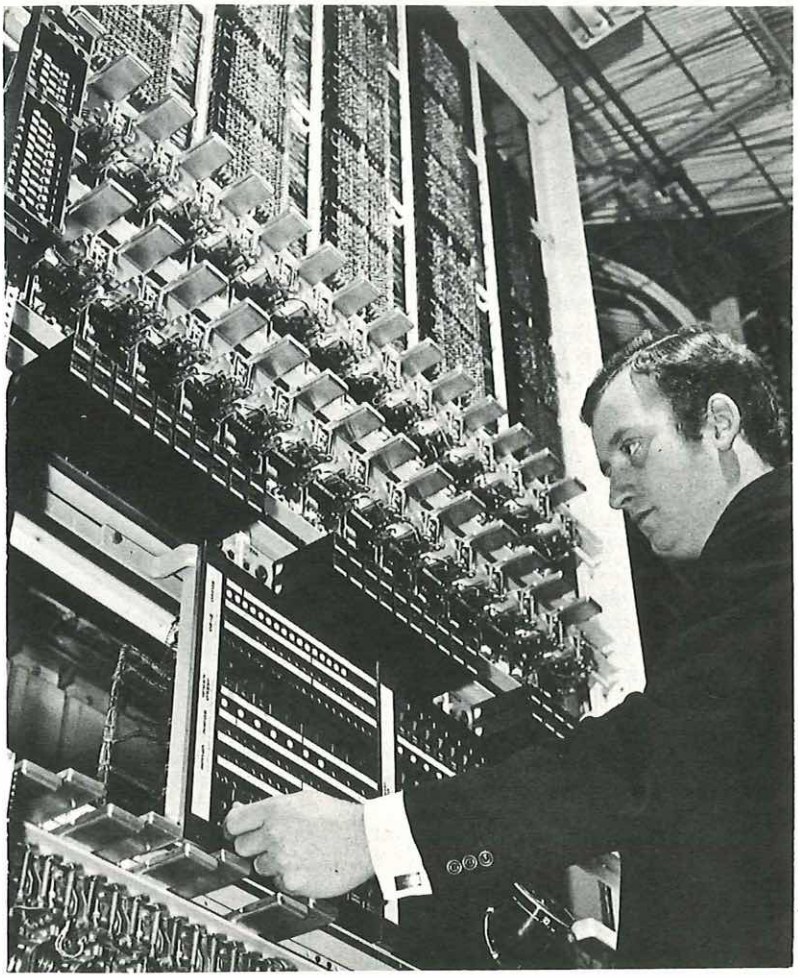
To provide the professional back-up facilities essential for the success of these developing publicity campaigns the agency selected for telecommunications advertising is Batten, Barton, Durstine and Osborn Ltd., a group with international links. The American parent company has, for some time, been the agency for Bell Telephone Co. advertising in the USA. Under the current contract, which began in April 1968, BBDO prepare creative proposals and media recommendations to Post Office briefs co-ordinated by the Publicity Division of the Marketing Department, headed by Mr. R. M. Stanley, the Publicity Manager. The Publicity Division is responsible for compiling and administering the annual publicity budget (which is subject to approval by the Post Office Board) on behalf of the various operational departments of Telecommunications Headquarters, and Regional Directors.

One continuing aspect of advertising which has not yet been mentioned is **recruitment** advertising which is handled by a different agency—Charles Barker. With the exception of most graduate and A-level posts, which are advertised centrally, the telecommunications business uses all forms of publicity to fill the numerous vacancies which occur throughout the country. The Publicity Division co-ordinates Regional requirements, briefs the advertising agency, supervises the advertising and liaises with the Personnel Department to ensure that recruitment publicity is carried out with the maximum efficiency at minimum cost, an aim applied to all forms of Post Office publicity.

Finding the faults

An all-out effort is being made by the Post Office to reduce spectacularly the number of faults occurring in the telephone service. This article describes the new equipment which is helping to make this possible.

By M. G. TURNBULL
and P. A. SCOTT



Operating the Trunk Route Service Measuring Equipment.

BY 1975 the Post Office aims to reduce the incidence of call failures in the automatic telephone service by 50 per cent compared with the decade before. This spectacular drop will be due largely to the increasing use of new techniques which are speeding up the process of fault detection in telephone exchanges.

One of the great drawbacks of Strowger switching principles, upon which the automatic telephone system in this country is based, is that the customer's service is directly affected by most types of exchange fault. This feature is difficult to avoid because control of call path selection is passed successively from one switching stage to the next by rather complex mechanical selectors. In the long term this problem will be eliminated by advances in technology. Already, in fact, new system designs now being brought into service—electronic and crossbar exchange systems are examples—have a much lower fault liability than Strowger equipment and can route calls so as to avoid a faulty switch.

However, with the economic life of an exchange exceeding 30 years, the present Strowger equipment will not only remain for a long time yet but will form the majority of the switching network for at least the next decade. As a result, the immediate aim must be to minimise the effect of faults occurring on existing plant by reducing the time taken for fault detection and rectification.

Routine tests and inspections form the general approach to Strowger exchange maintenance. The provision of automatic routine testing equipments, routiners, to carry out much of this work has been standard practice for many years. The aim of improving service by reducing the duration of faults can therefore be achieved by using routiners more intensively than before. To this end the frequency of routining is now being increased with the ultimate objective of testing all equipment every night.

Testing at night, rather than by day, has several advantages. The most important is that plant items found to be faulty can be removed from service before the start of the morning busy period. It also means that testing is being carried out at a time when the exchange is least busy, allowing many more plant items to be tested in the time available and so permitting each routiner to deal with a greater number of items.

Night operation would be costly if staff had to attend to record faults disclosed by the routiners. This can be avoided by coupling each routiner to a fault recording machine which prints a docket showing the identity of each faulty item and the fault symptom. On arrival in the morning, maintenance staff are presented with a record of faulty plant. An immediate retest of these items to confirm the symptoms enables staff to decide which should be taken out of service immediately and which can safely be left open to traffic pending fault clearance. One fault recorder can serve up to twelve routiners.

Automatic control by fault recording equipment requires special circuit arrangements in the routiner. In general, routiners designed since 1960 incorporate these arrangements. All others can be modified for automatic control and plans have been made for this to be done. The major modifications lie in the routiner access control circuitry and, to reduce the on-site work as much as possible, ready-modified replacement panels are being supplied for the more common routiners. The size of the modification program can be judged from the fact that some 250 man-years will be spent on this work. In addition, fault recorders must be provided where none exist at present and additional routiners installed to meet the latest basis of provision

where this is necessary. The complete program, costing approximately £5·3 million, is planned to be completed by March 1973.

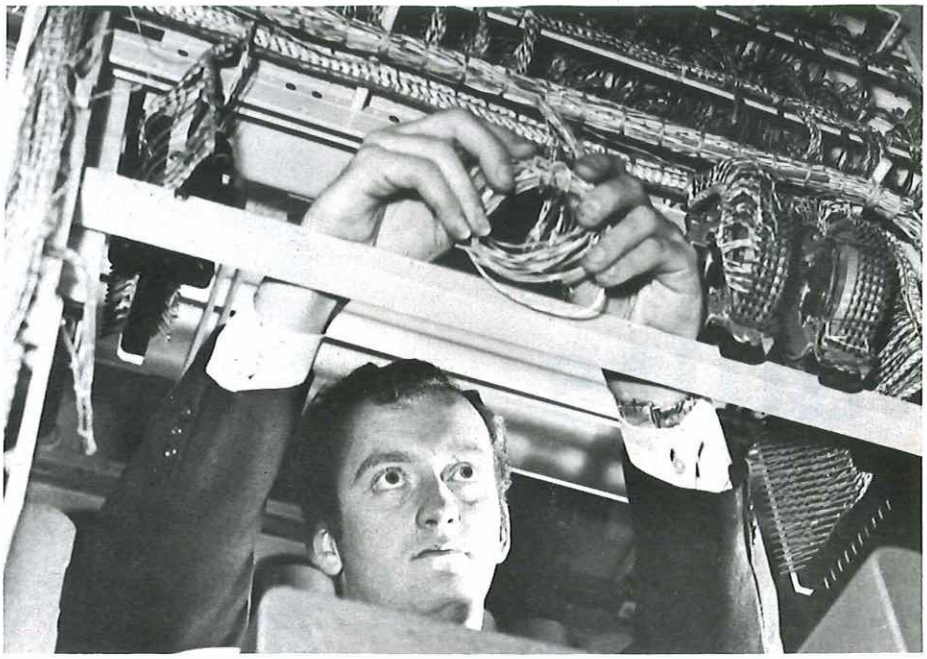
Operation of routiners at night is being implemented according to Area programs. Many exchanges, particularly group switching centres, trunk switching centres and 4000-type director exchanges, already have some routiners connected to fault recorders. These exchanges will see early implementation of the new procedures and will be the first to benefit from them.

It has always been recognised that there are certain parts of the system which are not covered by routine tests and reliance has been placed on the holding and tracing of faulty calls to find faults in these areas. With the increasing growth of the network, and the widespread introduction of STD, this method has become very expensive both in staff and circuit utilisation. Automatic call monitoring devices, Call Failure Detection Equipment (CFDE), are being introduced into exchanges to assist in the localisation of this type of fault and to determine the service given from a particular exchange.

Various forms of automatic monitoring devices have been in use for several years on a limited basis, and have in general been based on sharing the exchange Centralized Service Observation (CSO) access equipment. Standard forms of equipments, CFDE No. 3 and 4 are now being introduced for local non-director and director exchanges and design work is proceeding on a CFDE No. 5 for use in the STD network at large switching centres. These CFDEs incorporate their own access equipment and will sample calls on a random basis. Any call on which a supervisory tone is not received within a specified time period is regarded as having failed.

The equipment is designed to operate either in a service measurement mode or on a hold and trace basis. When used to measure service, the total number of calls observed and the total number of failures detected are recorded on meters; in addition digital information relating to each detected call failure is recorded on an associated printer together with an indication of the cause of the failure. When the CFDE is operated in the hold mode, and a failure is detected, the faulty connection is held, busy tone is returned to the caller and an alarm given to the exchange staff.

One weakness of non-standard CFDEs is that, when a call is held for trace, the calling subscriber's line is also held and immediate attention has to be given by exchange staff to release that part of the connection. CFDE No. 3, 4 and 5 have been designed so that, although the faulty connection is held for tracing purposes, the caller can clear and make a second attempt over alternative



A technical officer checks the Automatic Fault Recording Equipment.

selectors without the intervention of the maintenance staff.

To determine the performance of individual trunk routes forming the STD network, trunk line dialling tests have been carried out by operators for several years at the large trunk switching units. Automatic call sending equipment, Trunk Route Service Measuring Equipment (TRSME), has recently been brought into service to replace these manual tests.

Two versions of the equipment have been produced, a rack mounted equipment which has been designed specifically for use at the large switching centres, and a transportable equipment (Tester TRT 119) with a reduced number of facilities intended for use at the smaller centres.

The basic facilities of the rack mounted equipment include the origination of test calls from subscribers' calling equipments, from selectors, or from relay sets. In practice the equipment will be connected to the trunk selectors and the tests will therefore exclude the controlling STD register-translator equipment. Test calls can be originated on a maximum of 25 trunk routes to distant final selector numbers, and provision is made for a maximum of 25 final selector numbers per route.

The equipment is programmed, using clock control, to start a test cycle every hour during the normal working day. The program is arranged to vary the number of test cycles per hour up to a maximum of 10; the program insures that successive calls on each trunk route are to different test numbers. The received signals are identified and the results are recorded on meters for each route.

The original design of TRSME depended on the correct functioning of tone detector circuits to determine the success or failure of a test call. Early experience of the equipment showed that difficulties existed in the correct recognition of supervisory tones received on calls routed over certain types of trunk routes. This was due to the 'chopping' of the tones by supervisory signals. The equipment has now been modified to incorporate a reversal detector circuit which recognises the line reversal condition received from a standard test number circuit. It has also been found necessary to include a period of 400 Hz tone on recorded congestion announcements in order that these can be recognised by TRSME.

The TRSME is now operational at over twenty centres and present evidence shows that consistent results can be obtained from the equipment. It is considered that it will be a useful weapon in determining the performance not only of the trunk lines but of the incoming local switching network.

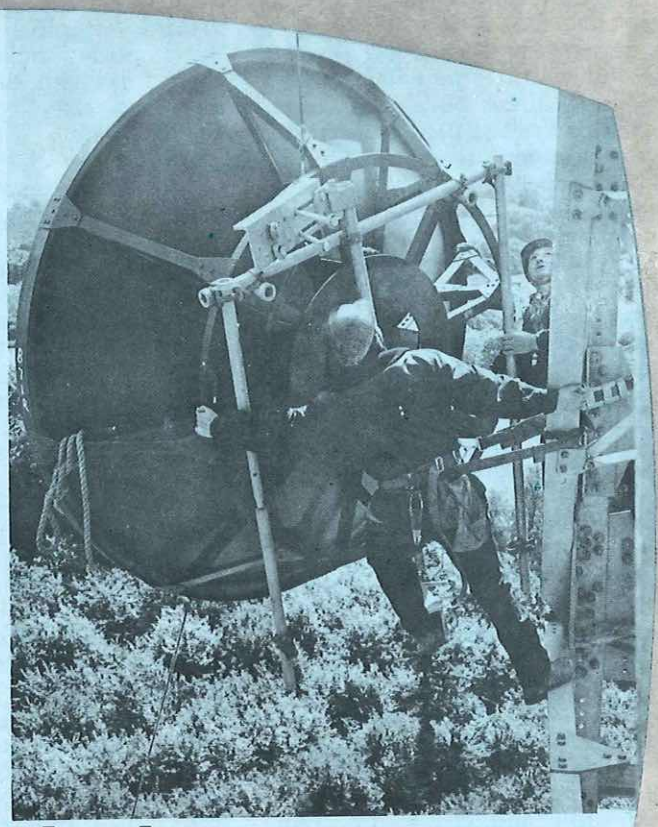
THE AUTHORS

Mr. P. A. Scott *is a temporary SEE in the Service Department of THQ with responsibilities for maintenance aspects of Strowger-type local automatic exchanges. He entered the Post Office at Bournemouth in 1944 and joined the LTR Headquarters in 1956. He transferred to the Engineering Department in 1964 and was concerned with local exchange maintenance procedures.*

Mr. M. G. Turnbull *is a SEE in the same Department, responsible for maintenance aspects of trunk exchanges and the overall performance of the STD network. He entered the Post Office in 1944 in London and transferred to Headquarters in 1950 where he was concerned with the development of exchange switching and signalling systems prior to taking up his present duties.*

More Colour Television

Colour television can now be seen on all three channels in much of the country. The Post Office played an essential role by providing microwave radio and cable links between television studios and the broadcasting companies' transmitters. It meant working round the clock to meet transmission deadlines.



by W. F. E. WELLER

COLOUR television has been available in this country since 1964 when BBC 2 started transmitting programmes in the Ultra High Frequency (UHF) band using 625-line standards. The extension of this service to BBC 1 and commercial channels has presented many problems for the broadcasting authorities and the Post Office. One of the biggest has been to change over from the existing 405-line monochrome services broadcasting in the Very High Frequency (VHF) band to a 625-line UHF system needed for colour television. A sudden switch would have rendered useless, practically overnight, millions of TV receivers in homes throughout the country. This problem has been overcome by using a planned method known as "Duplication". In effect it means that, for perhaps the next ten years, the 405-line services in VHF will be broadcast simultaneously in 625-line UHF.

To make Duplication possible it was agreed with the broadcasting authorities that separate 405 and 625-line networks would not be needed but that, as far as possible, the existing 405-line network of Post Office main, transmitter and studio links would be upgraded to meet the higher standards required for 625-line colour transmission; that 625-line signals would, in general, be transmitted over all Post Office links and that the authorities themselves would convert signals from 625 to 405-line standards at suitable points.

Preliminary studies showed that 80 per cent of the main inter-city links would need to be replaced. Most of these were on cable circuits which did not have sufficient bandwidth for 625-line colour transmission. Some microwave routes had channels available which were suitable for colour television, but there were many cases where new provision was necessary. In fact 31 new channels have so far been provided.

Modern transistorised video equipment had to be provided for existing transmitter links, and 20 new links made available to serve UHF transmitters.

Studio links presented considerable problems. In addition to upgrading those to existing studios for the BBC and commercial programme contractors additional circuits to new studios had to be provided due to changes in the areas served by programme contractors and the introduction of new contractors in London, Birmingham and Leeds. With new studios built for ITN, London Weekend and Thames TV in London, for ATV in Birmingham and Yorkshire TV in Leeds, 106 new circuits had to be made available. To complete this particular work programme on time necessitated the closest co-operation between Telecomms HQ, the Regions and Telephone Areas in phasing equipment and cable production and the installation and commissioning of links and circuits at short notice—all at a time when the volume and pressure of Post Office work has been increasing.

Co-siting of UHF transmitters in each area for both BBC channels and ITA was arranged which allowed one UHF aerial to serve all channels. The broadcasting authorities set up their joint UHF transmitters at the

most suitable of their VHF stations. However, to ensure maximum population coverage, it was necessary to introduce 250 additional low powered UHF only stations into the network. In general, these have been established as part of the BBC 2 expansion.

Complications arose with an ITA request—largely for control and staffing purposes—that programmes to the UHF transmitters should, where possible, first pass through their VHF stations in each area. While this presented no technical problems it did mean that extensions to circuits were necessary, sometimes over many miles, and involved a great deal of additional planning and work.

Despite the many problems the Post Office had in fact completed all its preparatory work when the "go ahead" for duplication was given by the Government in early 1967. With a completion date of Spring, 1970 for the first phase, covering London (Crystal Palace), the Midlands (Sutton Coldfield), Lancashire (Winter Hill) and Yorkshire (Emley Moor), the Post Office immediately placed contracts for radio links between London-Birmingham and Birmingham-Manchester to replace existing coaxial cable and obsolescent radio links and for the provision of new links between Manchester and Leeds. Associated existing and new transmitter and studio links were to be equipped by direct Post Office labour with modern transistor video equipment.

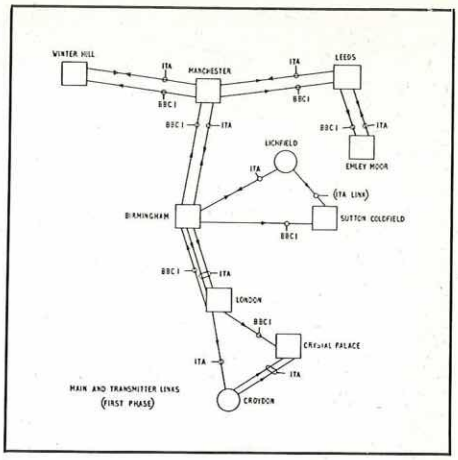
Although the Post Office was formally committed to make the first phase network available by Spring 1970, it was agreed that the broadcasters would be helped as much as possible in bringing some of the stations into operation before Christmas 1969. The fully-engineered radio links for the London-Birmingham-Manchester route could not be advanced, so initial service was given by temporary radio equipments for these links and the new transmitter links between Leeds (Tinshill) and Emley Moor.

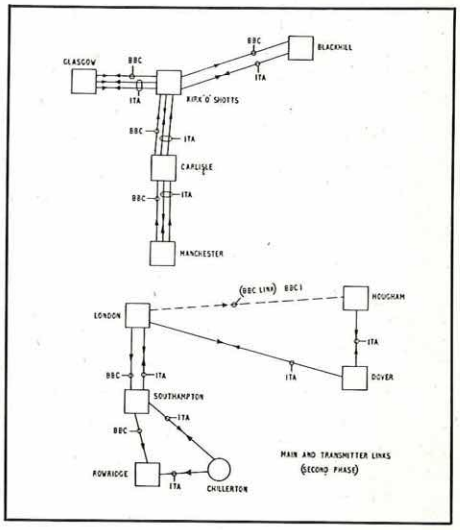
Temporary 1+1 portable radio systems were manufactured at short notice by a contractor and tested and installed by Post Office staff. Since installation they have proved very satisfactory and have been praised by the broadcasting authorities for the high performance standards attained. These temporary main links, made available to the authorities by early October 1969, will be replaced by the standard 6+2 systems.

The Post Office gave an assurance that all associated studio and transmitter links would be upgraded by mid-October, 1969, and, in fact, the re-engineered and new transmitter links to Crystal Palace, Sutton Coldfield, Winter Hill and Emley Moor were all completed and made available by that date.

The second phase of duplication, covering UHF stations at Rowridge, Dover and Blackhill (Scotland) came into service in December, 1969. The third phase progressively covers all UHF transmitters in the remaining areas and is expected to be spread over the next two or three years.

The introduction of 625-line UHF transmission on all channels will be noticed by the general public for at least two reasons. For one thing the design of home TV receivers should be simplified, cheaper single standard sets only being necessary. As these sets, either in colour or monochrome, increasingly come into use, TV reception in homes throughout the country will be to a higher standard than ever before.

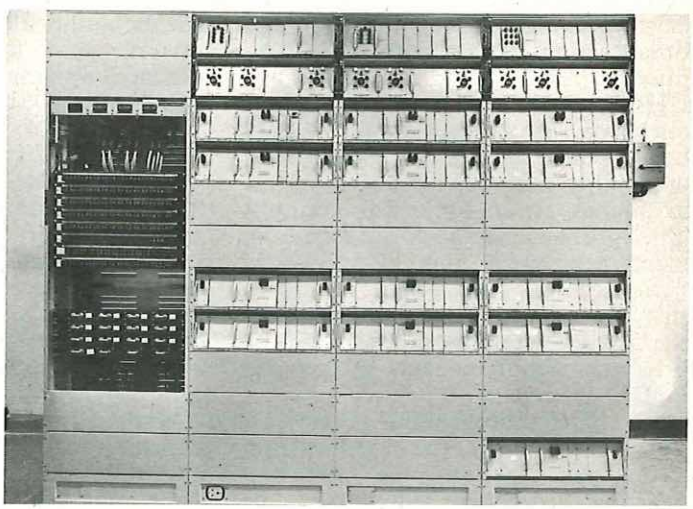




THE AUTHOR

Mr. W. F. E. Weller, CEng, MIERE, *is an Executive Engineer in Network Planning Branch and has been concerned with the planning of the Post Office network of television links since 1962. He joined the Post Office as a Youth-in-Training in London's North West Area. As Assistant Engineer he served with Lines Branch from 1951 until he took up his present duty.*

The first pictures to be published of the transistorised video equipment which the Post Office used to upgrade transmitter and studio links. Its big advantage over previous equipment is in its use of printed circuit cards. When a fault occurs the card can be removed, replaced immediately by a stand-by, and the faulty card repaired on the bench. As a result the transistorised installation need never be out of service



DIRECTORIES BY COMPUTER

▲THIS . . . REPLACES . . . THIS▼

By F. DUNN

THE first public telephone directory to be produced by computer will be issued in the Stoke-on-Trent telephone area in January, 1970. The computer is being used both to compile the directory and to give instructions for its printing. A further 38 directories will be computer produced during the following 12 months and other areas throughout the country will follow as their directories become due for re-issue.

The changeover from traditional methods has been made possible by the development by National Data Processing Service of a computer system which will not only compile public telephone directories but also deals with Directory Enquiry (DQ) records and supplements and provides information on the management of the operation.

The aims are to provide more up-to-date information for public directories—in the long term it is hoped to save up to a month in the overall production span—to produce better DQ records and to enable the Post Office to develop and maintain a pattern of directories more suited to the changing needs of customers.

New ideas for directories are now taking shape and the computer will be able to reorganise entries—which may be governed by the subscriber's address, telephone exchange or classification such as residential, small or large business—into any new directory which may be conceived.*

The first step is for the directory clerk in the Telephone Manager's Office to specify the subscriber's

*See Telecommunications Journal, Spring, 1969.

TOP: From a docket prepared by a Telephone Area Directory Clerk an operator at Leeds Computer Centre transfers the directory entry information to a punched card. In contrast BOTTOM: A clerk surrounded by the piles of paper work the old system involved. Here she is correcting entries, gumming them and pasting-up. With the new system she will write simple instructions on a small docket and the computer will do the rest.

directory entry on a punching document. This breaks the entry down into the elements which the computer has to identify in order to obey the sorting rules and contains supplementary information, such as a standard business classification.

At the Data Preparation Centre at Leeds, cards are punched and verified from the information submitted by the directory clerk and the punching documents returned to form the clerk's permanent record. The punched cards are read into the computer and it's first job is to carry out specified checks. Any record which fails a check is reported for attention. It is not possible to computer check all the items, for example mis-spelling in a subscriber's name or address, and therefore the computer also prints out details of those entries which have passed the checks. The directory clerks check the computer printout ensuring that the computer files tally exactly with the subscriber's requirements. Corrective input is submitted as necessary.

The computer compiles a sort-key for each record to locate the subscriber's entry in its correct alphabetical position and to provide a reference for updating purposes. Compiling the "sort key" requires looking at each element of the entry in turn, for example the surname, initials and street name. Each character in an element is carried to the "sort key" in computer language. To comply with sorting rules special procedures are taken—if a name starts with "Mc", then "Mac" is carried to the "sort key"; "St." is carried as "Saint".

Special codes ensure that, for example, "Smith S." is followed by "Smith T." and not separated by "Smithson". Similar processes are continued throughout the remainder of the entry until the complete sort key has been compiled. The exchange and subscriber's telephone number is carried at the end of the sort key ensuring that each record has a unique identity.

To help directory enquiry operators, common names, in addition to being alphabetically sorted, are listed in street order and frequently required services are grouped under classification, for example doctors, taxis. The computer does this by compiling special sort-keys and records.

The records are sorted by the sort-key and carried to the computer files which consist of Main, Suspense and Parking files and reflect DQ requirements. To provide DQ records the country has been divided into 60 geographic DQ areas. Every three months a new DQ record, which lists in alphabetical order all subscribers in the area, is produced for each of these areas. These records are up-dated weekly by the issue of cumulative supplements. Speed is essential and all input processes are carried out on the day of receipt of information.

A DQ operator answers a call. Computerised information will provide her with more up to date information.

Accepted entries first enter the Parking file which is a temporary store for input records. It is divided into five groups, one of which is used each day for the up-dating of the Suspense file. As the Suspense file is up-dated any record referring to a new subscriber or amending an existing entry is copied on to a magnetic tape which goes through an editing process. This removes control information, inserts punctuation, lines up entries in the format in which they will be printed and divides entries into columns and pages. Output from the editing process is printed to provide the DQ weekly supplements.

Following up-dating and editing of the Suspense file one DQ section of the Main file is up-dated daily. This process consists of running the DQ section of the Main file against the Suspense file and for insertions, carrying the new record into the Main file; for amendments, carrying into the Main file the amendment record in lieu of the existing record; for deletions, comparing the deletion due date with the current date and acting accordingly. Deleted records are held on file for four months from the date of cessation and printed in DQ records with the cessation date in lieu of telephone number. Once the DQ section of the Main file is up-dated, it is edited in a similar fashion to that for the Suspense file and printed to provide the DQ Operator's new record.

Most directory enquiry records and supplements will be produced from computer print-out. A high quality master copy will be passed to the Post Office's reproduction unit at Old Street, London, where it will be photographically reduced onto a master plate for printing by offset-litho. Records for very large areas such as London will use master plates produced by the Stationery Office using public directory techniques.

The computer system uses DQ files for the production of public directories. Since the order and detail of entries are the same in both, filing and processing time can be reduced. Flexibility, a prime requirement has been achieved by making a subscriber's entry suitable for the DQ record and any directory in which his name appears—input clerks specify the appropriate DQ geographical area only.

To obtain appropriate entries for a public area directory from the geographical sections of the Main file an index is used. This contains a list of the sections which may hold the required records and specifies parameters which justify inclusion. These may be the exchange or postal area and the subscriber's classification—residential, small or large business. Changing the area covered by a directory or providing new directories is a relatively simple matter. All that is necessary is to change the parameters in the index.

To compile a public directory each DQ section of the Main file which may contain the required entries together with its Suspense files, is run against the index. Appropriate entries are copied on to a magnetic tape. The tapes produced from the different sections of the Main file are then merged and edited to remove control information and insert punctuation. At this stage the directory consists of a magnetic tape containing a string of entries in their correct alphabetical order. The tape is then passed to the Stationery Office who carry out typographical editing and print the directory using highly sophisticated

photo typesetting and letterpress printing techniques.

Capital letters present an interesting problem. Input to the computer is in upper case. Since public directories are printed in upper and lower case a computer program has been written which will interpret from the content of a directory entry, where capital letters should be printed. Logical rules can be derived for most items but not all. For example, the letters "Mc" starting a name are generally followed by a capital letter but a few people prefer a small letter; some names begin with a small letter, for example, de-la-Rue. When any letter in a directory entry is not required to follow the computer program rules, the directory clerk will precede it by a special symbol which will have the effect of reversing the capitalisation rule.

Subscribers who rent telephones at several addresses have the entries grouped together into a "group entry". The order of the entries within the group often follows no logical pattern, and it is necessary for the input clerk to give an indication of the order. The facility which is being provided is for a subscriber to indicate whether he wishes an entry to appear at the top or bottom of the list of entries under a heading or sub-heading. The clerk will classify these entries as A or Z respectively, and this character will be used in the sort key.

The Post Office has recently introduced a new facility whereby a subscriber may have an entry in a directory in which he would not normally appear (out-of-area entry). The directory clerk will input the entry specifying in which directory it is to be included. A separate file of these entries will be held, and when the directory is produced will be merged with the normal entries.

When a subscribers number is to be changed, for example for exchange extensions or boundary adjustments, telephone directories anticipate the change and wherever possible a change is made to coincide with the publication of the directory. The computer system will provide for this and in directory enquiry records will print both the old and the new number and the date of change.

The switch to the new system is a huge operation for Post Office staff and when finally completed will have involved the transfer to the computer of all the names, addresses and telephone numbers of the country's subscribers.

THE AUTHOR

Mr. F. Dunn joined the Post Office as a Youth-in-Training in 1941. He transferred to the traffic side of the telecommunications business in 1950 and in 1966 joined the National Data Processing Service as a Senior Executive Officer to lead the Number Information Services project team.

The Computer Room at Leeds.

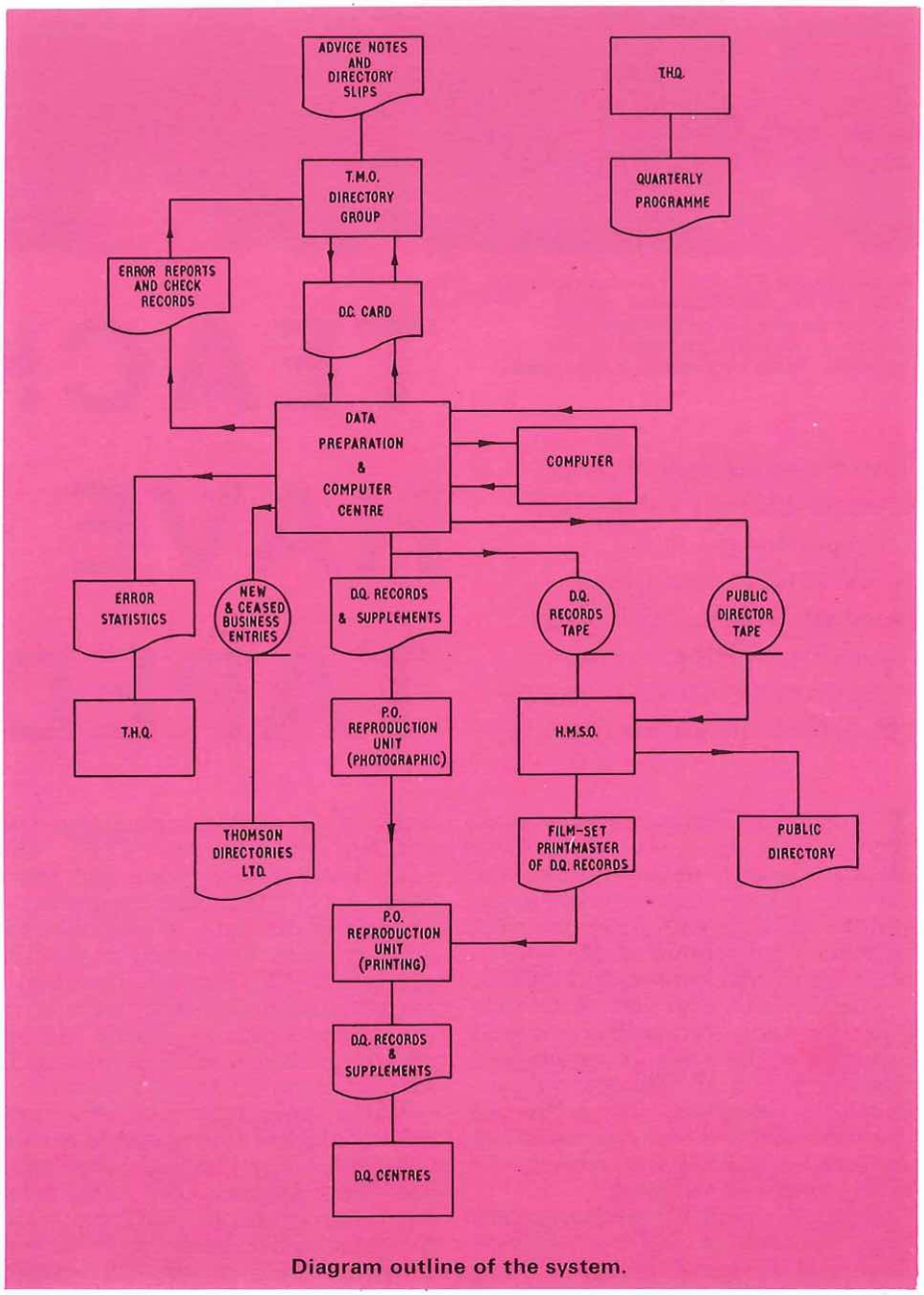


Diagram outline of the system.

Action in the TV studio as the recording team go through a dummy run. A trainee lecturer is practising his teaching technique in front of the cameras. Later he can see a play back.

TEACHERS HAVE GOT IT TAPED

The Post Office is using closed-circuit television for teaching. A TV studio has been built at Stone Technical Training College where teaching programmes are recorded on video tape.

By C. E. WOOLLEY

EDUCATORS have always found that the surest way to the mind is through the eye. From the days of pictures and diagrams scratched in the dust with a pointed stick teachers have reinforced the spoken word with visual symbols and models.

Visual aids today are extremely powerful tools for instruction and exploit a wide range of techniques. Possibly the most valuable yet produced is television. Its ability to display subjects in the classroom "on demand" ensures its increasing use in all spheres of teaching.

A closed-circuit TV system has now been installed at the Post Office's Technical Training College at Stone and is being used in conjunction with a video tape recorder (VTR). This equipment, though larger and much more complicated and expensive, is essentially the same as the domestic tape recorder. Connected to the output of a TV camera it makes a magnetic record on tape of the scene which the camera is viewing and can then be replayed, as often as wanted, for display on classroom receivers.

Video tapes have big advantages over traditional filming and projection techniques. For example, when making the recording, the cameraman does not rely on a picture frame viewfinder, an optical focussing device and a light meter to set the camera aperture. Instead, he observes the scene on a small monitor which works on the signals coming out of the camera and which, in exactly the same form, are being stored in the tape recorder. So long as the picture he sees on the monitor is good, he knows that the recording is good also. If it is unsatisfactory he makes the necessary adjustments and can see their effect immediately. No tape is wasted; the faulty shot is wiped off electrically and the later attempt recorded in its place. With film, he must wait until it has been processed before he can be sure of the results and, if a shot has to be retaken, not only is the exposed film useless but

it may be necessary to set up an elaborate scene all over again.

At the receiver end there are two points in favour of video tapes. The VTR, unlike a film projector, need not be in the same room as the viewers so that there are no problems of positioning it or of disturbance from noise. A TV display can also be viewed in normal lighting avoiding the problems of room darkening. Note taking and, for example, participation in an experiment by writing down tabular results can go on unimpeded. It is interesting that the brilliance of the picture, together with the high definition of a modern system, seems to make the relatively small screen quite acceptable to watch at distances rather greater than might be expected. This factor can be enhanced by the clever use of close-ups.

At Stone the first steps have been taken towards a scheme for putting on tape a range of subjects which can later be injected into lectures as required. There are two main categories of topics. The first embraces demonstrations or experiments which, conventionally, are carried out in laboratories and require students to move out of the lecture room from time to time to participate in them. A videotape recording minimises this movement and allows each student to observe the demonstration from an ideal position.

By careful production technique the standard of instruction can be kept very high and free from defects due to human factors. The first four recordings of this kind have been completely successful. Additionally, they save some 50 per cent of the time previously needed for this part of a syllabus. The saving comes from eliminating movement between classroom and laboratory, from simultaneous presentation to the whole of a class rather than repeated delivery to smaller parties and from editing out experimental difficulties to make the demonstration smooth but not glib or facile.

A different class of subject arises from the need to illustrate working techniques which cannot readily be simulated, or to describe equipment which is too complex, unusual or expensive to be provided as a training installation. For example, recordings have been made of a Pole Erection Unit in action and of an overhead cabling party engaged on live work. Again, equipment at the Goonhilly Satellite Earth Station in Cornwall which exists nowhere else in the country, has been taped and used to explain the operation of similar equipment which is to be installed in Italy and Spain.

Another recording goes into "the can". This time the programme deals with the correct way to construct a manhole.

Recordings of this kind, made on the spot, are not necessarily impaired by minor blemishes of technique. Indeed, their impact may be increased by touches of actuality. More formal presentations, however, require a smoothness of production which can only be obtained by a careful and disciplined approach. A detailed script must be prepared covering not only the filmed material and the commentary but also the mechanics of camera ranges and angles, of cuts from one camera to another, changes of lighting and so on.

Although it is not impossible to work under improvised conditions, irritating accidents are likely to happen to spoil a carefully planned sequence. A properly equipped studio is essential for good results. At Stone the specially built studio has a flexible overhead lighting system—correct positioning of lights is perhaps the most important single factor in production—a clear area of floor where cameras can manoeuvre freely and a control room overlooking the scene and linked by lamp signals and speech circuits to the operators on the floor.

To get maximum value from the system it will require to be linked to all classrooms—only some are currently equipped with receivers—so that, on a pre-arranged but flexible schedule, the appropriate recording can be called for and transmitted.

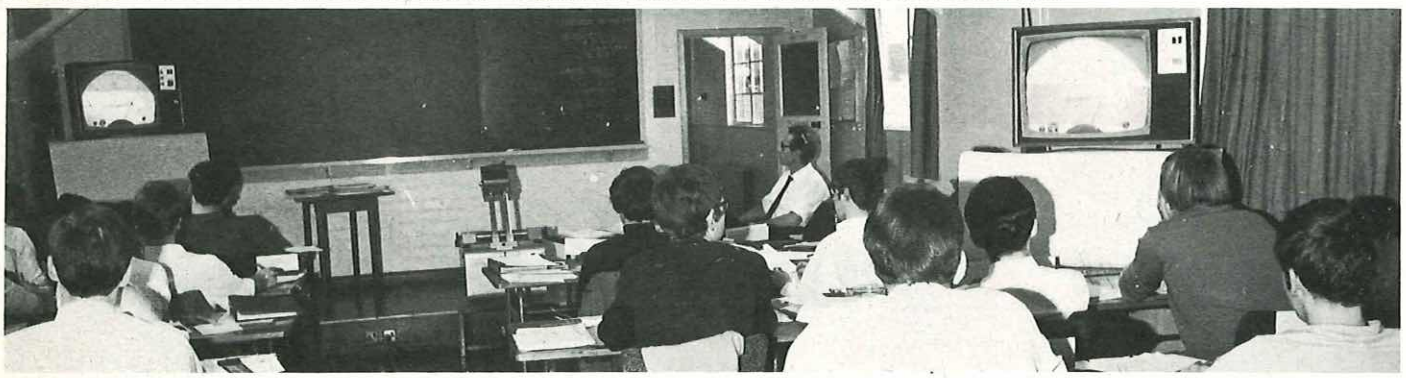
Such a system will take some time to build up, and the compiling of a comprehensive library of tapes is a formidable task. Nevertheless, the possibilities are considerable. For the future, it may be that the Stone studio will be the central transmission station for a round-Britain link-up of Post Office training establishments or, alternatively, that tapes from the Stone Library will be distributed to other training centres equipped with their own TV system.

Whatever form the developments, the VTR technique will have an increasing role to play as the work of the telecommunications business expands and diversifies. It is here to stay.

THE AUTHOR

Mr. C. E. Wooley *is Deputy Principal of the Technical Training College, Stone. He joined the staff of the College, formerly the Central Training School, in 1957 after working in Nottingham Telephone Area.*

Eyes glued to the TV screen, students watch a laboratory experiment from their classroom desks.



Ahoy! Colourful Cable ships

"Arîel" is pictured at the Glasgow dockside during her repainting and refitting.

Post Office cable ships have a new look. They have been repainted in bright colours which will stand out from their surroundings whether they are working in the ice packs off Greenland or in the fog-bound waters of the English Channel.

The new colours are International Orange for the hull, Light Admiralty Grey for the superstructure and Golden Yellow (the new telecommunications safety colour being used on motor vehicles) for masts, cranes, funnels and lifeboats.

Making the cable ships more conspicuous should reduce the risk of collision at sea. Despite modern navigation aids such as Radar, cable ships can be a danger to other shipping, especially in bad visibility. Often they are stopped when on cable repairs or, if laying cable on a fixed path, cannot manoeuvre freely. Other ships are expected to keep clear.

Interference with cable operations should also be reduced. In the past, with identification of the cable ships difficult in poor conditions, trawlers have often come too close and endangered the cables. Now they should have even less excuse for not staying well clear.

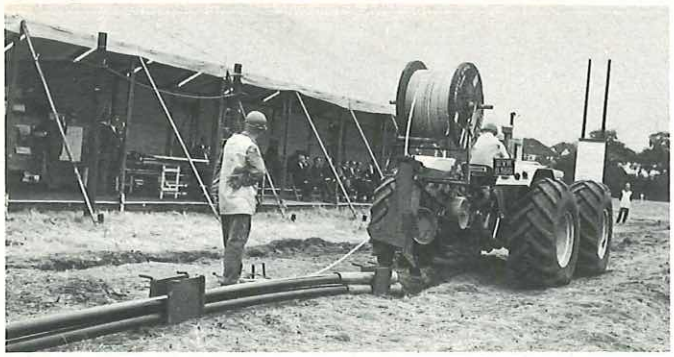
The shade of orange used on the hulls is internationally recognised as a colour easily seen at sea. While a gloss paint has been used on the superstructures of the smaller ships "Ariel" and "Iris", a harder-wearing but more expensive polyurethane paint has been used as an experiment on the bigger "Alert" which often operates in extreme weather conditions. "Monarch", the fourth cable ship, has yet to be painted.

Despite overcast conditions in the Firth of Clyde, the bright colours of "Alert" make her easy to see.

Captain Ian Nairn of the "Iris" commented: "The new colours are undoubtedly a big advantage in poor visibility. The Golden Yellow of the small boats, often used for shore-end work, can now be seen a long way off."

The new livery is the fifth colour change in the Post Office's cable ships. Before the First World War colours were black hull and yellow funnel. Immediately after that war until the early 1960s the ships were painted Admiralty Grey. Then followed hulls in bronze green (the old engineering colour) with buff funnels. But this was not very successful as the appearance of the ships was not enhanced.

Shortly afterwards white hulls and buff funnels were adopted which was the livery until the recent change. This was a very good colour scheme as it enhanced the yacht-like appearance of the ships, but it was a difficult colour scheme for working ships to keep clean.



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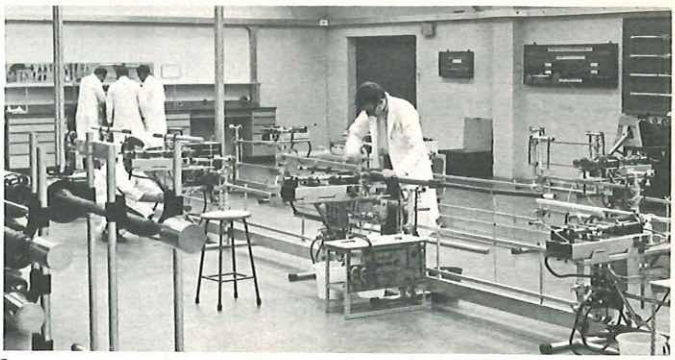

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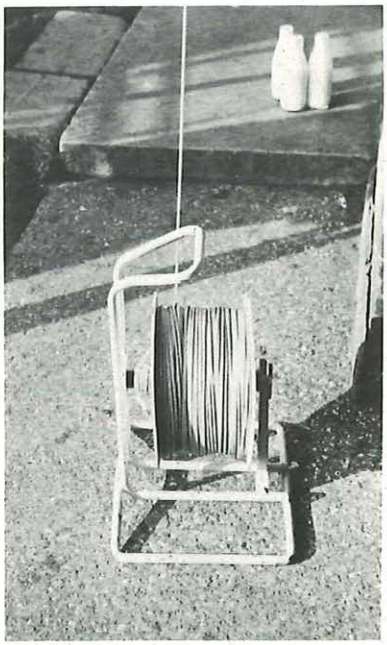

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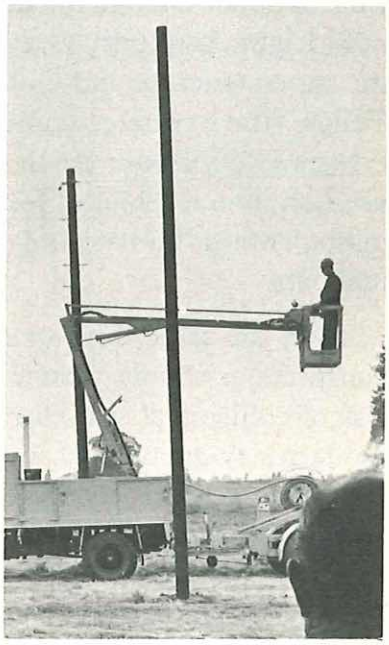
External plant on show

By S. J. LITTLE



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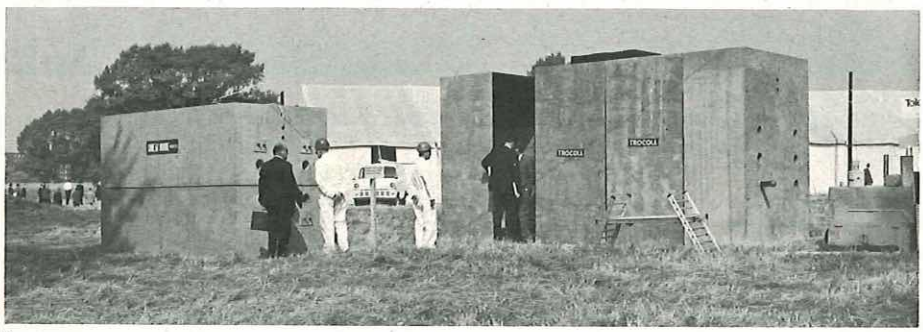

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1: Moleploughing duct and cable with a four-wheel drive tractor in front of the demonstration tent at Northwick Park.

2: The submarine cable jointing laboratory at Carlton House, new home of the Civil and Mechanical Engineering Branch.

3: The drop wire dispenser which enables one man to erect cable over a minor road.

4: Aerial cabling at Northwick Park with an elevating platform.

5: A display of prefabricated manholes.

FOR a number of years it was customary for the External Plant and Protection Branch, or more familiarly Cn Branch, to organise Open Days to show their latest developments to Regional and Area personnel. TD8, as the lineal descendant of Cn Branch, continued this tradition in September, 1969, with an exhibition staged at its new Headquarters in Carlton House, Kenton.

A nearby field at Northwick Park was taken over temporarily to allow heavy field equipment to be shown, and an arena was laid out in which demonstrations could be staged before several hundred spectators seated in a large open-sided tent. The main emphasis of the practical displays, all with running commentaries by members of TD8, was on productivity. The first showed moleploughing cable with a winched plough. This was followed by an illustration of simultaneous moleploughing of 2–3½ in. diameter PVC ducts and a polythene sheathed cable by a four-wheel drive tractor, a method expected to achieve considerable savings when fully exploited. . .

In the next demonstration two men, equipped with a vehicle-mounted, hydraulically operated elevating platform and winch, erected quickly and safely a light aerial cable along and over a simulated road. With this method the cable is taken out to site on a cable drum trailer towed by the vehicle and the trailer set up at one end of the route to be cabled. With one man at the vehicle controls and the other in the elevating cage, the latter is raised with the free end of the cable to its working height. The vehicle is then driven slowly over the route, drawing cable off the drum as it proceeds, the operator in the cage attaching the cable to each pole as it is reached.

A solo installer and his vehicle demonstrated a method, now on extensive field trial, which enables the installer equipped with a simple wire dispenser to provide a telephone service involving an overhead crossing of a minor road. Before development of the method on display this operation required the assistance of a second man, not only for the work itself but also to control traffic. To facilitate the work, in particular the loading and unloading of ladders, the installer's vehicle was equipped with

a new form of ladder rack and a ladder designed to ease its erection at walls or poles.

A new rodding and light cabling vehicle on trial in several Regions was seen next. The vehicle has a crew of two men and is fitted with a vehicle-engine driven compressor supplying air to a pneumatically operated winch, a road breaker, a submersible pump, ductmotors and a recently developed rod-pushing device. This device pushes a plastic rod through the duct to be cabled and pulls the cable back after it as the rod is withdrawn. Alternatively, the winch can be used to pull in cable if this is more convenient. Very high performances can be achieved by this vehicle, which is currently capable of dealing with cables of up to 100 pairs and 500 yards in length. These are taken out to site on a trailer towed by the vehicle itself.

Although the Post Office now deploys over 100 specialised pole erection vehicles it is frequently not economic to use these for pole recovery. A demonstration was therefore staged to show how two men, with an ordinary stores carrying vehicle fitted with a simple hydraulically operated crane as standard equipment, can safely and quickly recover poles.

The final demonstration was of the prototype of a large underground cabling unit capable of taking to site and drawing in the largest cables. The equipment comprises a cable pulling unit, virtually an hydraulically operated winch mounted on a heavy lorry chassis, and a self loading articulated cable drum transporter capable of carrying two large and two medium size fully loaded cable drums. This demonstration indicated quite convincingly that, when crewed by three men, the unit could readily deal with the installation of the larger underground cables, a task which when carried out by conventional methods, is amongst the most arduous operations in the external field.

Apart from the staged demonstration, there were a number of other exhibits on the Northwick Park site. These included experimental asbestos cement joint boxes and massive experimental prefabricated manholes employing precast concrete techniques. Also demonstrated was a method of cleaning oil-contaminated joint boxes, making holes through concrete manhole walls for new ducts with a large diameter diamond drill and thrust boring. Water pumping equipment was shown in operation and the capabilities of road breakers were demonstrated on a specially cast reinforced concrete slab.

The exhibits at Carlton House were devoted to illustrating the work done in the jointing, cable development, structural design, protection, tools and safety fields. Visitors were able to see work in progress on the development of jointing techniques for both submarine and land cables. This included demonstrations of the Machine Jointing No. 4 developed by Research Department for jointing multipair cables which is capable of making joints of high quality and consistently low resistance at a rate of 200 or more pairs an hour. The method used to joint the recently introduced aluminium cable conductors was also demonstrated, together with methods of closing cable sheath joints by epoxy putty and other techniques.

Submarine-cable jointing equipment and the plant used to test joints made by jointers under instruction and in operational conditions could also be seen. There were illustrations of the work of the cable development group which has a special responsibility for the development of wires and cables and rationalisation of types used by the Post Office. On display was a model of a "moving bend" test plant, a novel concept simulating the stresses imposed on underground cables as they are drawn into ducts.

The effect of 50 Hz and noise voltages induced into adjacent telecommunications cables by an electric traction system was illustrated with the aid of a model railway. Examples of the techniques used to protect telecommunications circuits against induction from high voltage power lines and lightning were also demonstrated. The group responsible for the structural design and standards of self-supporting towers and guyed masts demonstrated its work with the aid of models, diagrams and photographs and an impressive display embracing many facets in the engineering safety field attracted much attention. A variety of tools and plant used in the external and internal field was also on show.

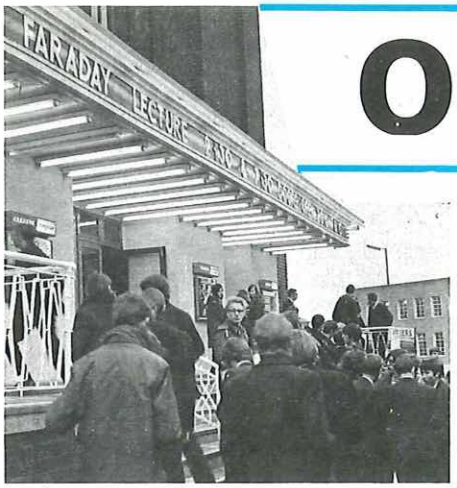
Approximately 5,500 visitors attended the exhibition. These included members of the new Post Office Board, Directors of Telecommunications Headquarters Departments and Regions and many Headquarters, Regional and Area personnel. Representatives from a number of overseas administrations, the nationalised industries and British and foreign contractors also attended.

THE AUTHOR

Mr. S. J. Little *joined the Post Office in 1930. After 20 years on power work, he moved to protection duties in the Engineering Department. He spent five years in Management Services and is now an Assistant Staff Engineer working on the development of mechanical aids in the external field.*

Staff Engineer Mr. A. C. Croisdale points out details of the rodding and light cabling equipment to Lord Hall, Chairman of the Post Office Board. With them (right) is Mr. A. W. C. Ryland, Deputy Chairman and Chief Executive. The rod pushing device has been taken out of the vehicle for display.

ON TOUR



PROFESSOR James Merriman, Board Member for Technology, is giving the 1969–70 series of Faraday Lectures with the aid of a Post Office team drawn from a number of departments. The lectures, given under the auspices of the Institute of Electrical Engineers, were introduced by Michael Faraday in 1924 and are aimed at explaining to the layman, in straightforward language, advances in electrical and electronic science and technology.

The lectures pay tribute to the memory of Michael Faraday, the eminent British physicist, who discovered electro-magnetic induction. To be asked to give them is one of the greatest honours of an electrical engineer's career.

Professor Merriman has chosen as his subject "People, communications and engineering". The lectures, which began in November, will be given in 13 cities and towns throughout the British Isles and will take six months to complete.

With at least two, and sometimes three, presentations at each venue a 12-man Post Office team is assisting the Professor, and Mr. C. A. May, a Staff Engineer in Telecommunications Development Department, is Deputy Lecturer and will stand in when required.

In charge of the presentation team is Mr. D. J. Holmes, an Executive Engineer, who has been appointed Tour Manager.

Describing the theme of the lectures, Professor Merriman says: "They dwell on the way in which scientists and engineers in telecommunications and postal engineering respond to the changing needs of society, generate new technologies in their search for scientific truth, and put those technologies to everyday use in the service of man."

Four main examples are used in the lectures. The first deals with the challenge of providing the Scottish Highlands and Islands with a completely new telecommunications system and shows how modern techniques of microwave radio and coaxial cables are being used to contribute to the changing pattern of everyday life in these remote areas. The lectures describe how a major multi-million pounds engineering project is planned, organised and managed.

The second example shows, through the eyes of project managers, engineers and technicians, one of the many ways in which large-scale telecommunications engineering is matched to the growth of the highly industrialised areas of South East England. The planning and organisation of a very large Group Switching Centre—the one at Brentwood in Essex—is described.

The third part tries to show how a young development engineer grapples with the problems of postal mechanisation, and describes the plans to bring technology into the highly labour-intensive postal service, so that its productivity and efficiency can be maintained.

A fourth theme deals with research. In this Professor Merriman seeks to reveal some of the special attitudes of mind needed by engineers and scientists in this field and shows how they are preparing to meet the vast telecommunications and data explosion of the latter part of this century.

For one of the "live" experiments a computer will be used to try to recognise the handwriting of a member of the audience. A closed-circuit TV system will also be employed. In another experiment a laser will be used in an attempt to bend or twist a beam of light without mechanical intervention—an experiment which Faraday himself first achieved with a candle in 1845.

Referring to the team effort being put into the lectures, Professor Merriman says; "This itself can be seen as a final illustration of the lecture theme. For society, increasingly, depends both on individual inventiveness and brilliance and upon the cohesive, co-ordinated co-operation of many members of diverse engineering, scientific, managerial disciplines, so that the 'people' who form society can reap the potential benefit of modern technological and scientific opportunity."

Tickets for the lectures are free from local organisers of the Institute of Electrical Engineers. Dates and venues of presentations are: 13 January – Albert Hall, Nottingham. 15 January – Victoria Hall, Hanley, Stoke-on-Trent. 29 January – Philharmonic Hall, Liverpool. 10 February – City Hall, Sheffield. 17 February – Sophia Gardens, Cardiff. 19–20 February – Central Hall, Westminster, London. 17 March – City Hall, Newcastle. 19 March – Usher Hall, Edinburgh. 15 April – Royal Society Hall, Dublin. 17 April – William Whitla Hall, Belfast.

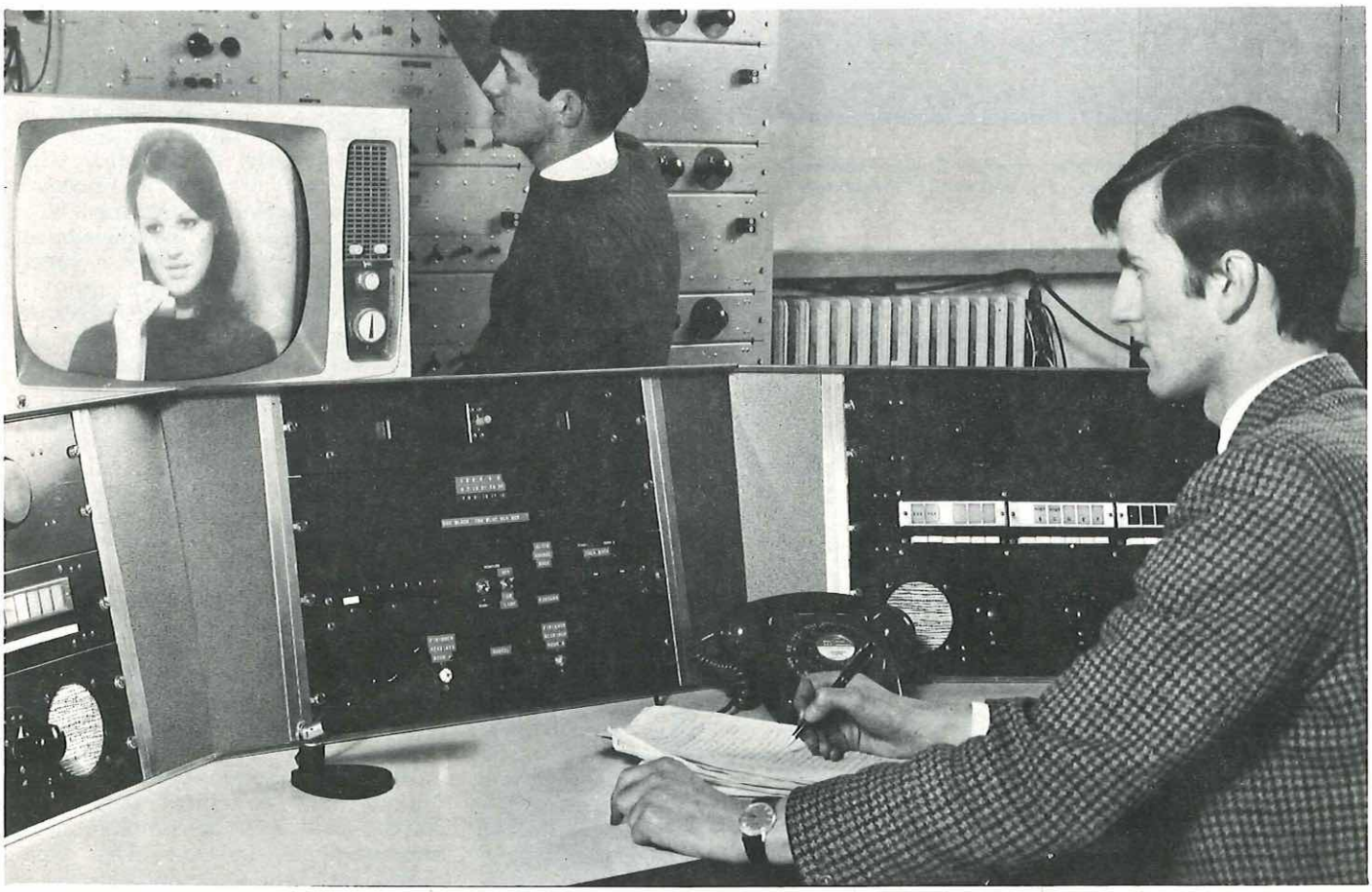
Special presentations for Post Office staff only are to be held at Central Hall, Westminster, London, on 28 April.

Professor Merriman (right) and Mr. C. A. May inspect equipment for the Faraday rotation experiment—twisting the electro-magnetic fields in a beam of polaroid light. The large meter shows the magnetic field strength. On the bench is a laser, magnet and polaroid detector unit

Volunteers help improve the telephone service

Free conversation tests as an aspect of overall telephone performance assessment have been conducted at Dollis Hill for many years. Recently new accommodation, with equipment embodying several novel features, has been commissioned specifically for these tests.

By
R. F. YATES



Test controller, Mr. Stephen Alexander, seated at the control console from which he can conduct all aspects of the speech test.

WITH something like 12 million telephones now in use in this country, it is imperative that the Post Office has equipment which will give the best possible performance within the network. Investigations to determine the relative performance of telephone sets are frequently carried out by the Post Office's Research Department, in association with the Telecommunications Development Department. There are three broad categories into which these tests fall—objective measurements; subjective tests; and free conversation opinion tests with which this article deals in detail.

Briefly, objective measurements are made in the laboratory to establish such criteria as the variation with frequency of sensitivity, impedance and transmission efficiency. Subjective tests are controlled and highly formalised and include certain artificialities. For example, trained speech-testers, skilled in speaking at controlled levels and controlled distances, carry out tests to determine the relative 'loudness' between two telephone sets, one being the item under test and the other with known characteristics agreed by CCITT laboratories in Switzerland.

With free conversation opinion tests, pairs of untrained volunteers use the telephone under near-normal conditions. The essence of the tests is to get the volunteer subjects to converse freely over the link being assessed and to collect their opinions of the connection.

The transmission link consists of two local telephone circuits coupled by a four-wire circuit in which the signals from each end can be sufficiently separated for instrumental measurements, for example speech voltage, to be made. Unlike the other tests which, for the sake of precision, introduce artificialities such as controlled speech levels, the conversa-

The measuring console, staffed by Mrs. Phyllis Redmond and Mr. Richard Oduraiya, which provides facilities for tape recording and speech voltage measurement.

A volunteer subject, Miss Monica Cannings, receiving instructions from Mr. Terry Young, one of the controller's assistants.

tional test includes all those human factor aspects normally present in telephone use, for example the manner in which a person holds the handset and the effect on his vocal level of changes in his received level.

The two subjects are seated in separate speech test rooms in which the surrounding noise conditions can be controlled. The rooms are constructed to be reasonably sound proof and are decorated and furnished to create a relaxed atmosphere. The controller and his equipment are in a control room adjacent to that of the subjects; to aid the controller's concentration the control room has been planned to give pleasant working conditions away from the distractions of the laboratory. The test is conducted by means of a comprehensive inter-communication and monitoring system, but the conduct of a free conversation test involves a strict timetable with little room for error.

The facilities provided include closed-circuit television for observing the way in which the telephone handset is held and a confidential voting system for obtaining the independent opinions of the subjects. The controller is assisted by two officers who take care of the monitoring aspects of the test, measuring speech voltages and making tape recordings.

The subjects are chosen at random from a large pool of volunteers from the Research Station staff and, because they may not know each other, it is essential to provide a means of stimulating a balanced conversation. It is very difficult at times to get subjects to converse freely. A recent development to help in this direction involves the use of pairs of colour slides drawn from a bulk supply and shown to the subjects on back-projection screens. The slide pairs are basically similar but have a number of controlled differences of a type that can be easily detected. Each subject sees only one slide of the pair and is required, by discussion with his partner, to establish what the differences are. By this means a two-way conversation covering a wide range of topics may be developed.

Each conversation under a specified test condition lasts for approximately five minutes and when finished each subject is asked to give an independent opinion of the quality of the conversational link by selecting from a list of answers. A frequently used list includes such opinions as excellent, good, fair, poor, bad, these being scored numerically from four to zero respectively. For each circuit condition, therefore, a mean opinion score can be evaluated. This score, together with the mean speech voltage from each end, may be presented graphically and, by comparing the curves of the two telephones or circuits in the test, the performance of one relative to the other may be determined.

Free conversation testing of telephones must be considered in the context of a series of complementary measurements. In view of its complexity and cost it cannot be used to evaluate the effects of minor changes in telephone set design. But it is an essential part of the assessment of any major new development in the telephone field.

THE AUTHOR

Mr. R. F. Yates *is a Senior Executive Engineer in the Local Telephony and Human Factors Branch of Research Department. He joined the Post Office as a Youth in Training in 1952 and was appointed to the Research Department Acoustics Laboratory upon promotion to A.E.E. in 1959. Since then he has been engaged upon numerous projects embracing acoustics, local telephony and the telephone assessment aspects of human factors engineering.*

Listening for an alarming sound

By F. E. WILLIAMS

Fire alarm bells in buildings may soon be a thing of the past. Research at Dollis Hill carried out for the Post Office and other Government Departments has resulted in the development of loudspeaker signals which can be used as alarms.

EXPERIMENTS are being carried out at Dollis Hill with new fire alarm systems which may eventually be used in all public buildings throughout Britain.

The new alarms, using acoustic signals through loudspeakers, have been made possible by modern developments in micro-electronics.

Alarm bells, of course, have been used in Post Office buildings for a variety of purposes. Bells will continue to be used as bandit and intruder alarms. For postal machinery alarms, buzzers—or alternatives which would not be confused with other systems—are proposed.

The proposed new fire alarms, however, will use two distinctive acoustic signals—one to alert occupants of a building without unnecessarily alarming them; the other, of a more compelling nature, to signify "clear out". A feature of such a two-stage alarm would be that, in the event of a small fire in a remote part of a very large building, the controlling officer would be able to evacuate staff stage by stage. This would avoid dangerous congestion of stairways such as could be caused by everyone attempting to leave at the same time.

Volunteer Janette Woodward, a Drawing Office Assistant at Dollis Hill, gives her reactions to the experimental alarm sounds to Executive Engineer Mr. E. G. T. Johnson.

The choice of suitable acoustic signals for the alarm obviously involved human factors. As a result the problem of choice was given to the Human Factors Group at Dollis Hill where a substantial background knowledge had already been accumulated in an investigation of the requirements of tone callers for telephone sets. A subjective investigation, a close study in this case of human reaction to various acoustic signals, was made on similar lines to the tone-caller study.

Points to be considered were the obtrusiveness of the signal under environmental conditions of noise such as is likely to be encountered in various types of Post Office premises; the feelings of urgency likely to be engendered by the signal and the engineering problems involved in producing the signal cheaply from small electronic apparatus.

Two signals were finally evolved and submitted for approval to the Working Party set up jointly between the Post Office, the Ministry of Public Buildings and Works, the Department of Employment and Productivity (HM Inspector of Factories) and the Home Office (HM Fire Inspector).

For the alert the recommended signal consists of a series of bleeps of tone synthesized from two mixed equal-amplitude sinewaves of 1000 Hz and 1333 Hz at the rate of one bleep per second. These bleeps can best be described as being somewhat similar to the telephone busy tone. So that staff can continue working while still being reminded that a state of emergency exists, the bleeps are not sounded continuously after the initial warning period but are restricted to small bursts repeated at intervals.

For the "clear out" a much more urgent-sounding two-tone signal has been evolved in which a tone with equal-amplitude frequencies of 600 Hz and 800 Hz is alternated rapidly with a tone of equal-amplitude frequencies of 756 Hz and 1010 Hz. It has some similarity to the well-known "Hee Haw" ambulance siren but as it has a different frequency content and a more rapid rate of alternation, it is nevertheless noticeably different.

The next stage in the experiment is likely to be the manufacture of equipment for a practical trial of the signals in Post Office premises. If the trial is successful, both from the human factors angle and from the cost aspect, then the new signals may eventually be adopted as a national standard for use in all public buildings.

THE AUTHOR

Mr. F. E. Williams *is a Staff Engineer at the Dollis Hill Research Station in charge of the department dealing with subscriber apparatus and human factors in telephony.*

CPM GETS THE ARROW RIGHT ON TARGET

By J. A. McDONALD

In the last ten years a new planning technique—the Critical Path Method—has been used throughout the world. CPM has been applied to a number of Post Office projects with the aim of improving planning efficiency. This article includes a step-by-step explanation of the technique.

London Telecomms Region uses CPM techniques for all major projects, including the South Bank (Rampart) outgoing trunk unit. Pictured on site are (from left): Mr. T. J. Beningfield, Clerk of Works MPBW, Mr. A. C. Walter, LTR Engineering Accommodation and Mr. J. Scott of the CPM team.

THERE is no shortage of management techniques designed to help the manager who is involved in planning a project or policy. The aim is to improve his thinking before he becomes committed to a particular plan, to increase his knowledge of what is happening once the project is under way and to enable him to take any necessary action to ensure that the project is completed when required.

The Critical Path Method of analysing a project is one technique which can help to achieve this aim. As with many management techniques, the basic concept of CPM is comparatively simple. The work to be done on a project is analysed into easily identifiable tasks, called activities. Each activity is represented on a diagram by an arrow, and the sequence in which the work is to be performed is indicated by arranging the arrows to form a network. By obtaining time estimates for each activity, dates can be derived for succeeding stages of the project. The network and the information it contains can then be used to plan and control the project.

The technique is also known by other names including Critical Path Analysis (CPA), Network Analysis, and Programme Evaluation and Review Technique (PERT); these may be considered synonymous. First used about 1958, the technique achieved early acclaim by its successful application to the United States Polaris Missile Project on which a saving of some two years was claimed. Since then it has been employed in the US space programme and widely throughout the world, mainly on large civil engineering and construction projects. The Post Office first used it in 1963 and has since applied it to many projects of varying sizes, including the planning and installation of major trunk switching units, the Reed Relay Selector project, Goonhilly Earth Station, the automation of telecommunications in the Highlands and Islands, transfer of the Savings Bank to Glasgow and the setting-up of GIRO. It has also assisted effectively on many smaller projects such as adaptation of new buildings, examining installation methods on Standard Automatic exchanges, installation of schools closed circuit television systems, etc.

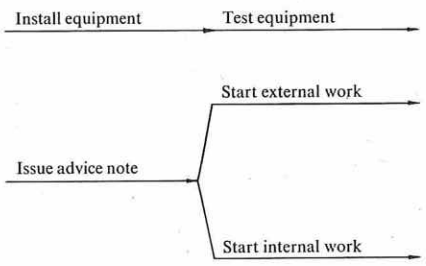
BASIC TECHNIQUE

A CPM network is based on three main elements: (a) Activity, (b) Event and (c) Dummy Activity.

Activity.

Any project is made up of a number of individual jobs, which are known as activities. Each activity is represented by an arrow with the tail indicating the beginning of the activity and the head its completion. The activity description is written above the arrow.

Networks are formed by drawing activity arrows in the sequence dictated by the work to be performed: Networks are drawn from left to right and are not to scale.

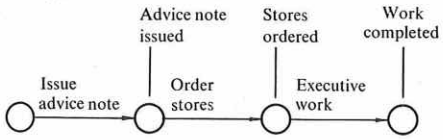


Events.

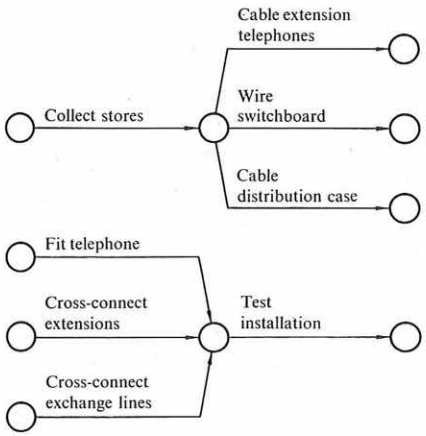
The beginning and end of an activity are called events and are normally indicated by a circle.

The event represents an easily identified point of achievement on the project, e.g. advice note issued, work completed, etc.

It is normal practice to label only key events such as building ready for entry, contract let, etc.



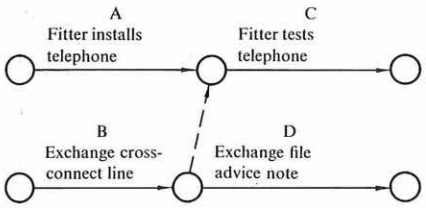
Several activities may start or finish at the same event.



Dummy activity.

This is a convenient method of showing the relationship between particular activities on the network by means of the broken arrow. Its principal use is to make clear the sequence of work by showing how one activity is dependent on another.

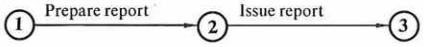
Consider the following situation involving four hypothetical activities, A, B, C and D:



The direction of the dummy arrow indicates that C is dependent on B and that D is not dependent on A, i.e. A and B must be completed before C can start and B must be completed before D can start.

EVENT NUMBERING

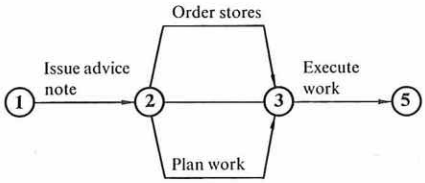
Events are numbered as a means of identifying activities:



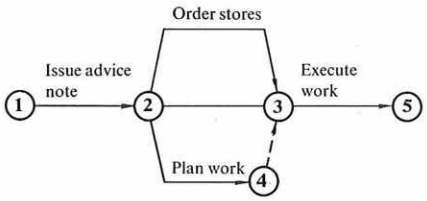
"Prepare report" is identified as activity 1,2.

"Issue report" is identified as activity 2,3.

The sequence of event numbers in a network is not significant, but the identity of each activity must be unique. With parallel activities care must be exercised, e.g.



As drawn, two activities (order stores and plan work) are identified as 2,3. To correct this the network is re-drawn using a dummy activity.



Issue advice note = activity 1,2
Order stores = activity 2,3
Plan work = activity 2,4
Execute work = activity 3,5

The logic of the network has not been changed but the identity of each activity is unique.

NETWORK CONSTRUCTION

Using these basic elements we can now start to draw the network.

(a) Break down the project or procedure in consultation with those responsible and list the activities to be performed.

(b) Note the sequence of activities and the constraints which apply, e.g. which activities must be completed before the next activity can start.

(c) Start with any convenient activity and build up the network by applying the following questions to each activity in turn:

(i) Which activities must be completed before this activity can start?

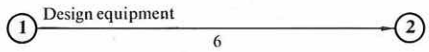
(ii) Which activities may start at the same time as this activity?

(iii) Which activities may start as soon as this activity is completed?

In this way we gradually piece together the network until it represents how the work is to be performed.

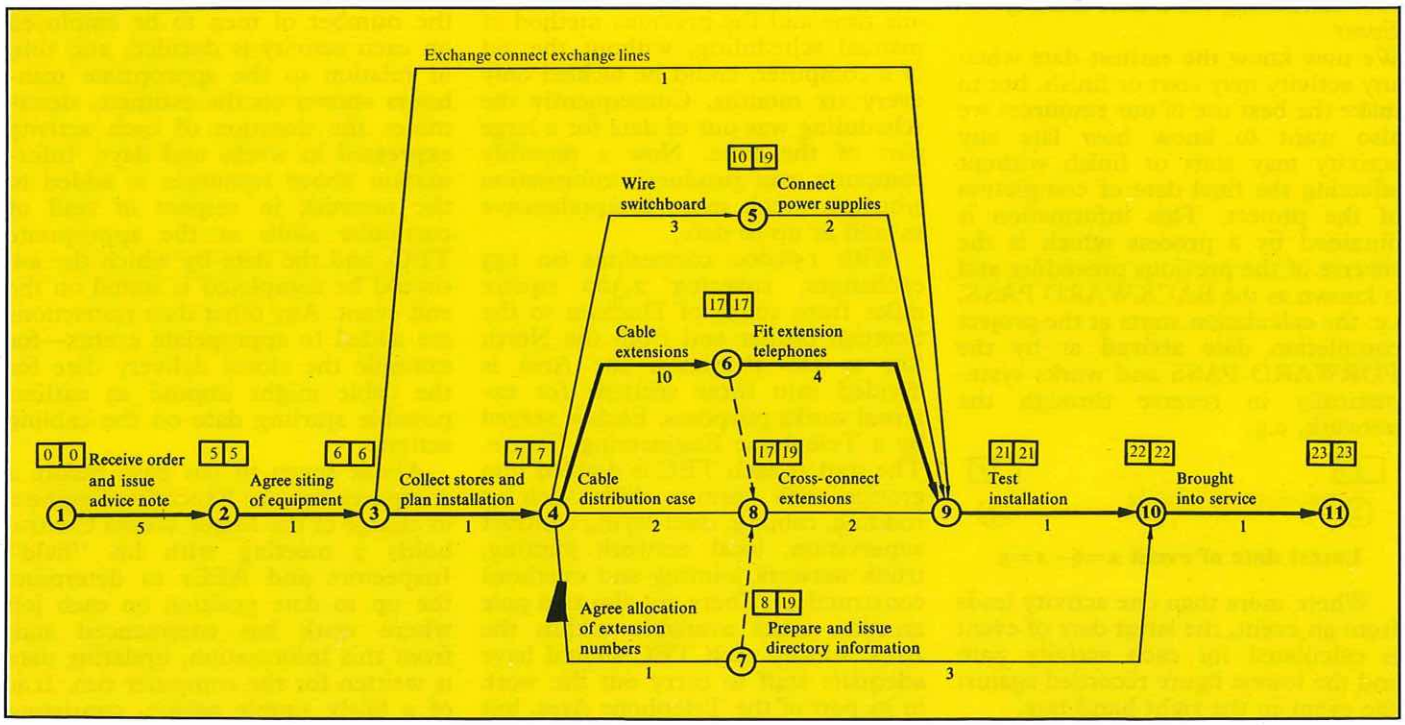
SCHEDULING

The network records the method to be employed; now we must consider the time requirements. Officers responsible for each activity are asked to estimate the time required for their completion taking account of past experience, pressure of other work, etc. This duration is shown immediately below the activity arrow.



The time unit employed is not significant, providing all estimates are in the same unit. From the

A complete network for the provision of a PBX.

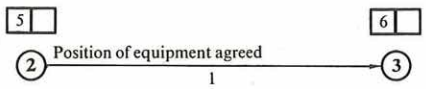


duration information we now calculate the earliest and latest dates by which each event can occur, remembering that all activities leading to and from an event must be considered. Two separate processes are involved.

(a) Calculating the Earliest Date of Event.

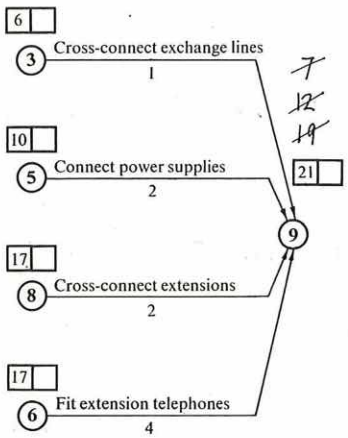
The Earliest Date of an Event is defined as the earliest time by which all the activities leading into that event can be completed. It is recorded in the left hand box above the event. The process of calculating the earliest dates of events in a network is known as the FORWARD PASS.

Earliest date of an event=Earliest date of preceding event+duration of the activity leading to it.



Earliest date of event 3=5+1=6

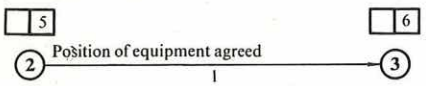
Where more than one activity leads into an event, the completion date of each activity is calculated and the highest calculated figure applies.



Take highest calculated figure
Earliest date of event 9=21

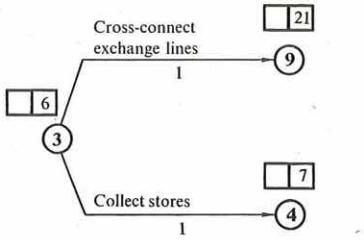
(b) Calculating the Latest Date of Event

We now know the earliest date when any activity may start or finish, but to make the best use of our resources we also want to know how late any activity may start or finish without affecting the final date of completion of the project. This information is obtained by a process which is the reverse of the previous procedure and is known as the BACKWARD PASS, i.e. the calculation starts at the project completion date arrived at by the FORWARD PASS and works systematically in reverse through the network, e.g.



Latest date of event 2=6−1=5

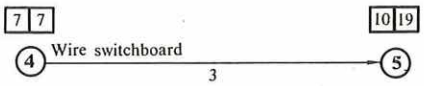
Where more than one activity leads from an event, the latest date of event is calculated for each activity path and the lowest figure recorded against the event in the right hand box.



Lowest calculated figure=7−1=6
=Latest date of event 3

FLOAT TIME

Having completed the forward and backward passes we know the earliest and latest start and finish dates for each activity and we can use this information to compare the time required to complete an activity with the time available to find the spare or "float" time if any, e.g.



Time required = 3
Time available=19−7=12
Float time =12−3= 9

Knowledge of this kind indicates that the activity can start as early as day seven or as late as day 16 without affecting the end date of the project, and the float time available can be used to employ the staff on other work.

CRITICAL PATH

By calculating the float on each activity in the network, we can identify those with zero float. These activities are said to be critical because any delay in their completion will delay the project. They form a continuous path or chain of activities through the network, which is called the Critical Path, and is normally indicated by a broad or coloured line. The critical path is the longest time path through the network. It also represents the shortest duration in which the project can be completed. To improve the overall project duration, one must reduce the duration of activities on the critical path, perhaps by using more resources. There is no point in attempting to reduce the

CPM IN THE NORTH EAST

FOR the past two years a computer has been used in the Newcastle upon Tyne Telephone Area to produce up to date schedules for work on major projects. The aim of the experiment is to make the best use of the staff and time available for group 2 external works in the area—those over 750 manhours. There are usually about 100 planned group 2 jobs in hand at any one time and the previous method of manual scheduling, without the aid of a computer, could be tackled only every six months. Consequently the scheduling was out of date for a large part of the time. Now a monthly computer run produces information which is much more comprehensive as well as up to date.

With 156,000 connexions on 143 exchanges, covering 2,300 square miles from south of Durham to the Scottish border and from the North Sea to the Pennines, the Area is divided into three sections for external works purposes. Each is served by a Telephone Engineering Centre. The staff at each TEC is divided into groups with various skills such as rodding, cabling, duct-laying contract supervision, local network jointing, trunk network jointing and overhead construction. There are also two pole erection units available within the Area. Ideally each TEC should have adequate staff to carry out the work in its part of the Telephone Area, but in practice the loads fluctuate and one of the problems is to know well in advance whether staff of a particular skill should be loaned from one TEC to another, or alternatively, whether one TEC can help out another by taking over certain works.

At the planning stage a simple arrow network diagram for each job is prepared and passed to the Works Group. From the nature of the job the number of men to be employed on each activity is decided, and this, in relation to the appropriate manhours shown on the estimate, determines the duration of each activity expressed in weeks and days. Information about resources is added to the network in respect of staff of particular skills at the appropriate TEC, and the date by which the job should be completed is stated on the end event. Any other date restrictions are added to appropriate events—for example the stores delivery date for the cable might impose an earliest possible starting date on the cabling activity.

About seven to ten days before a computer run the Executive Engineer in charge of the Major Works Control holds a meeting with his "field" Inspectors and AEEs to determine the up to date position on each job where work has commenced and, from this information, updating data is written for the computer run. It is of a fairly simple nature, consisting

overall project time by improving the duration of non-critical activities.

USING THE NETWORK

When the network is finally agreed, it becomes the master plan. Once the project is under way, the network can be used to monitor its progress at regular intervals; up-to-date information is obtained from the officers responsible not only on the completion of work but also on activities which have yet to start to confirm that the agreed dates will be met. This continuous process of looking forward is essential if remedial action is to be taken in time.

Readers interested in learning more about the technique are referred to a booklet called Critical Path Methods (CPM) Technique produced by THQ/ Management Services Department. Also available at the same Department is a programmed learning machine which can teach the basic technique in under two days.

CPM is an excellent tool for considering how best a project can be tackled, including time scale. This initial process of thinking through a problem is an excellent discipline and may be confined to as few as 10 to 20 activities; a simple network can be much more easily assimulated than four or five pages of typed script in assessing the feasibility of a project. There are many simple problems where CPM can help, e.g. launching new services, adapting accommodation, organising conferences, Telephone Weeks, introducing new procedures, training, etc. Being a very flexible system CPM can be applied to a project as a whole or merely applied in depth to select sections only. When special action is necessary, the network provides a ready means of considering the alternatives. It will also highlight the urgent tasks and enable effort to be concentrated on them.

The Telecommunications Business is essentially a multi-project organisation and with growth of the system the separate programmes for buildings, equipment manufacture and installation, external works, radio-links, etc. increase in size and complexity, and there is need to integrate these programmes to ensure an early return from investment. The Highlands and Islands Scheme for bringing an automated telecommunications system to the less densely populated parts of Scotland is a good example of how CPM can help to tackle this type of problem in the field.

THE AUTHOR

Mr. J. A. McDonald *joined the Post Office in Scotland in 1939 (on Christmas Day!) He moved to London in 1960 and worked on the setting up of telephone traffic analysis equipment. Promoted CTS in 1965, he became involved in evaluating and fostering CPM. He is now a PTS in Management Services Department on the implementation of the customer rental records computer project.*

CPM is being used for major projects in the Newcastle upon Tyne Telephone Area where external works are programmed with the aid of a computer

By D. R. BARRETT, *who joined the Post Office at Bradford in 1937 and has served as a TTS in Leeds Telephone Area. He joined North Eastern Region Headquarters in 1960 and is now a CTS in the Planning Division.*

mainly of the "time remaining to completion" on activities which are in progress. From time to time, however, durations of future activities are amended and, on new information from the planning group, "required by" dates on the end events of networks are altered. Concurrently, the work of writing out the data for the new jobs which have been received from the planners proceeds. This is more complicated than the "progress" data, but is simplified by the use of pre-prepared forms.

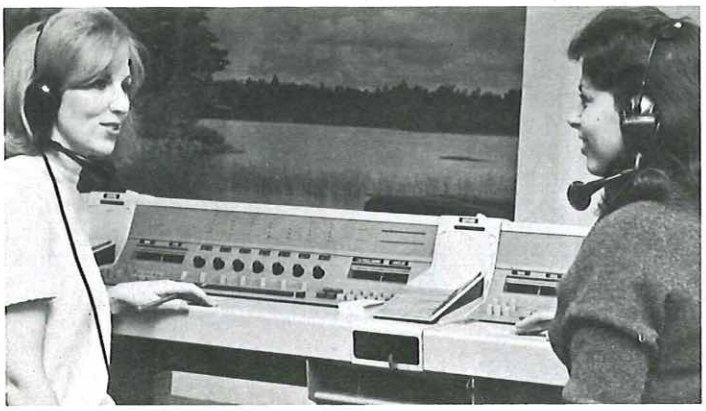
The computer run is carried out at the Newcastle upon Tyne Corporation's Computer Centre, using an ICL 1903, and the run usually takes about 45 minutes. In addition to the network data for each job, the computer is given information about the number of men of each type of skill which it may assume to be available at each TEC for group 2 works. Having determined the earliest and latest dates and thus the float, or spare time, available for each activity by normal time analysis, and taking into account any dates which have been placed on particular events, the computer proceeds to schedule work so as to make optimum use of the men specified to it as available resources. So long as resources continue to be available it can schedule activities anywhere between the earliest and latest dates found from the time analysis. When, however, a resource has been exhausted during a period where the computer finds it still has

Executive Engineer Mr. G. C. Dutch and Assistant Executive Engineer Mr. E. J. Hurst sitting at the console typewriter of the Newcastle computer.

work to be scheduled, it must be instructed what action to take. For example, it can be told to exceed the "required by" date, in which case the job will be finished later than required; alternatively it may schedule not later than the "required by" date and in so doing exceed the resources allowed. If desired, the computer can be asked to carry out resource analysis on both bases, and thus produce outputs which will respectively show either what completion delays will be experienced or what level of staff will be needed to meet the programme dates. In practice the latter type of analysis has been predominant.

With the ICL 1900 PERT program the user has the facility for designing a wide range of output, and full advantage of this has been taken. The output schedules showing work execution times have been designed in bar chart form because it is felt that most people can more readily assimilate information from this type of presentation than from a long list of dates. One bar chart for general management lists all jobs, but for each Inspector an individual chart is produced showing only his work. Various tables have been designed to show, for each TEC and for the whole Area, the numbers of men of the various skills required daily for the following month, and weekly for one year. Side by side with the required figures are listed the number available and unused; the latter is of course a negative figure where the computer has had to exceed available resource. A monthly running aggregation of the number of added pairs which will be produced by the work as programmed is also given.

This experiment has successfully shown that the ICL 1900 series PERT program facilities can handle the type of work scheduling problem which exists on major works in a large telephone area, but consideration is now being given to extending the experiment to include small works and to take account of priorities. No radical change in the basic principles of the system are involved; the main problem will be one of dealing with the need for a much larger quantity of data.



Cordless switchboards are now standard for new exchanges, the Post Office points out in its comments on the productivity report. The picture shows the switchboard which recently came into service at Croydon, Surrey.

BRITAIN DOES WELL IN PRODUCTIVITY STUDY

THE United Kingdom telephone system shows up to advantage in a report which compares telecommunications productivity in this country, the Netherlands and Sweden. The report, sponsored by the Post Office Economic Development Committee, is a detailed examination into the differences in labour productivity—and the reasons for the differences—in the three countries.

Three types of work were covered:

1. Switchboard operations at automanual exchanges.

The report says the number of calls per hour handled by operators is substantially higher in the UK than in the Netherlands or Sweden. The volume of traffic handled by an automanual exchange in the UK is about twice the volume handled in the other two countries. The report adds that this gives rise to economies of scale which account for a major proportion of the difference in productivity. As the STD system grows there is a risk that the UK will lose this advantage, unless automanual exchanges are combined.

The Netherlands and Sweden have advantages of faster working equipment (e.g. cordless switchboards used extensively in Sweden) but this is not likely to have a marked effect on the productivity figures.

2. Maintenance of local cables.

Labour productivity in the UK measured in man hours per fault is twice as high as in the Netherlands and 25 per cent higher than in Sweden. But overall performance—man hours per week per mile of cable—is 80 per cent higher in the Netherlands and 20 per cent higher in Sweden. This is due to the lower fault rate in those countries. The report points out that the Dutch bury armoured cables direct in the soil instead of placing them in ducts. The average duration of a local cable fault in the UK is 50 hours, compared with 80 hours in Sweden. The maximum duration of cable faults in hand in the UK is 4.5 days, while the Dutch take "more than a week" and the Swedes about ten days.

3. Maintenance of subscribers' apparatus.

The fault rate in UK public call offices is seven times as high as in Sweden, reflecting the cost of vandalism. But excluding public call offices, labour productivity on subscribers' apparatus is roughly the same for the UK and Sweden, both of which are roughly 30 per cent below the Netherlands.

Time spent in drawing stores and refuelling vehicles is significantly higher in the UK. In Sweden the average length of time a telephone is out of service due to a fault is very much higher, but because of a lower level of fault liability of apparatus the Swedish overall performance (man-hours per week per thousand telephone sets) is twice as good as the UK or the Netherlands.

The study was carried out by a group, under an independent chairman, which included representatives of the Post Office, the trade unions and the secretary of the Economic Development Committee. The EDC has recommended that the Post Office extend the studies to other fields.

POST OFFICE REPLY

The Post Office in an official statement on the report, says:

Telephone switchboard operations—During the past twelve months, the introduction of improved procedures has resulted in a saving of over 2,000 operators, and further improvements are in prospect. Cordless switchboards are now standard for new exchanges, and design work has commenced on a new type of cordless switchboard which will be capable of controlling calls from customers on exchanges possibly up to 100 miles distant. This will give, among other facilities, great flexibility in traffic handling allowing of some switchboards being closed during slacker periods. It will also enable the Post Office to retain the "advantages of scale".

Maintenance of plant—Changes in the organisation of the maintenance service, which will bring considerable overall gains in productivity, have been made recently. Looking to the future, arrangements are in hand for the first trial of computer control of fault recording and maintenance operations.

The statement adds that the Post Office is accepting the recommendations of the EDC that further comparisons in other fields shall be undertaken.

Miscellany

£8m contract for research centre

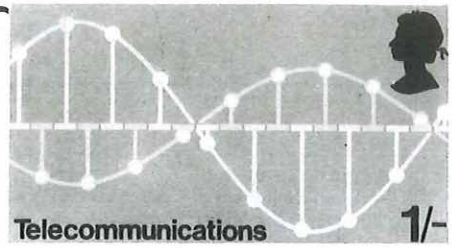
THE Post Office has signed an £8 million contract for the building of its new scientific and technological research centre at Martlesham, near Ipswich, Suffolk. Building of the research centre, expected to be the finest of its kind in Europe, should be finished by the end of 1972. It will give the Post Office Research Department ample space for expansion and large-scale field experiments that cannot be attempted in the Department's present home at Dollis Hill, London.

• A comprehensive description of plans for the research centre will appear in the next issue of *Telecommunications Journal*. There will also be an article on research into waveguide systems which is already being carried out on the Martlesham site.

1990 telephone?

This cordless telephone operates with microwaves and has no mouthpiece—speech can be transmitted while it is held against the ear. So far it is only a designer's dream of the 1990s. The telephone was part of the telecommunications exhibition at the Design Centre—see page 4.

ALEC REEVES LOOKS IN THE CRYSTAL BALL



FOUR special stamps marking the Post Office's technological achievements were issued in October—birthday of the new corporation. One of them (above) featured Pulse Code Modulation which enables up to 24 telephone conversations to be made over one circuit simultaneously.

Alec Reeves invented PCM in 1937. Now aged 67, he is still creating ideas at Standard Telecommunications Laboratories, Harlow, and thinking about the future of telecommunications. He has made some fascinating predictions recently.

He believes that by the year 2020 "the wandering subscriber" will have to be catered for—that any person, anywhere, will need or want to be able to talk to any other person anywhere else. This will become feasible, says Mr. Reeves, with a combination of PCM, optical fibre waveguide transmission and conventional radio.

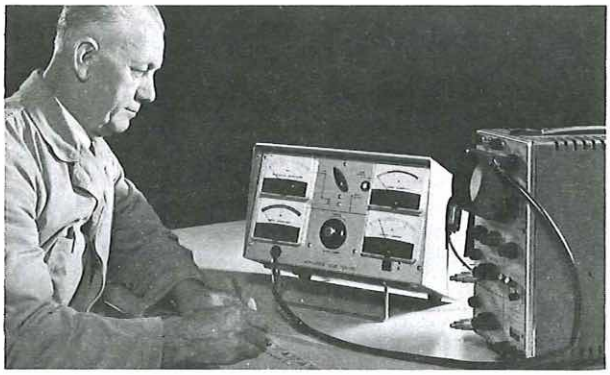
In the optical wavebands, he points out, seven thousand million good quality speech circuits per waveguide are theoretically available. He thinks cheap, reliable, mass-produced optical fibre is likely within 20 years and room temperature lasers for the repeaters perhaps within two years.

Mr. Reeves also predicts completely mobile world-wide personal telephone numbers. Assuming that world population in 2020 is about 16 thousand million, even if only one quarter of these become subscribers, 42 binary digits would be enough to identify each with reasonable reliability he says.

About 100 numbers, enough for most people, would be stored on a magnetic tape contained in a personal pocket radiotelephone. Any number to be called would be selected using a pair of small wheels moved in decimal steps according to personal directory numbers. This would select the correct point on the tape and a head would then read off the 42 digits into the world network, probably through an intermediate store to allow read-out at an accurate, appropriate rate. These pocket devices would plug into fixed sub-sets, says Mr. Reeves, for immediate optical connection, or into vehicle systems or be used independently when necessary.

If the number to be called is not known Reeves forecasts that speech recognition machines will almost certainly have been developed to the point when one will ask a store for the number and get it in a matter of milliseconds. Such stores, he says, will probably be electro-optical using hologram storage in crystals with laser-beam access.

Dollis Hill tests for safety



An appliance is tested for electrical safety.

A NEW electrical safety tester has been developed by engineers in the Research Services section at Dollis Hill. It will be used to test some 20,000 items of electrical equipment in regular use there. No commercial device has been available for this job.

The tester can determine earth insulation of an appliance; measure load current taken by it so that the correct fuse can be used, and measure impedance of the earth core lead when a current of approximately double the fusing current of the fuse link is passed for one minute.

The tester has revealed a high fault level in appliances. Between seven and 10 per cent of all equipment so far tested has had defects or definite faults. As a result, a work programme is in hand at Dollis Hill for the testing of all equipment as soon as possible. A number of testers are being built by Research Department workshops for this purpose.

So far, no steps have been taken to release the tester for general use, but all information and drawings will be available from Dollis Hill on request.

New Board Member

Mr. A. S. ASHTON has joined the Post Office Board as Member for Finance and Corporate Planning. He was formerly Executive Finance Director of Esso Petroleum Limited and his appointment is for four years.

Lord Reith writes

Sir,

I feel that the new institutional arrangements under which you work—which incidentally I recommended *mutatis mutandis* in 1922—justify my writing again, after some years, to congratulate you on the Journal, and to wish you increasing satisfaction and success with it.

Reith of Stonehaven Kt.

BITS AND PULSES

LINCOMPEX, the Post Office invention which almost eliminates the effects of radio interference and makes maximum use of transmitter power, is proving an export winner for Britain. Over 500 Lincompex point-to-point equipments have been sold by GEC and STC—mostly to overseas customers. Design royalties payable to the Post Office should more than offset development costs.

– 0 1 0 –

A new £3 million cable will treble submarine cable circuit capacity between Britain and Scandinavia. To come into operation in 1973, it will run between Scarborough and Thisted in North Jutland (380 nautical miles) and will carry 1,260 circuits. This is equivalent to the three largest-capacity cables in the world, which the Post Office will bring into operation between this country and West Germany, Belgium and the Netherlands during 1971/72.

– 0 1 0 –

Christopher Columbus Prize Fund award winners for 1969 are: Scientific Premium (£15), Dr. P. A. Watson. Craftsmanship Premium, R. E. Kelham and S. E. Alexander (£10 each); R. V. Barber, P. J. M. Ford, R. J. Patel, A. Rigo and R. G. Skegg (£3 each). The prize fund was set up by Sir Gordon Radley, former Director General of the Post Office, to give annual awards for craftsmanship and for the publication of articles by young research scientists or engineers.

– 0 1 0 –

The Teletourist Service is proving more popular than ever. Calls to the service in London and Edinburgh totalled nearly 299,000 in the quarter ended 30 September —over 18,600 more than in the same period the year before. The Edinburgh service—in English only—attracted over 12,000 calls. In London calls rose from 264,667 to 286,751—English 151,471, French 59,234, German 38,229, Spanish 32,319 and the new Italian service, started on 21 July last year, 5,498.

– 0 1 0 –

In the article dealing with engineering safety problems (*Telecommunications Journal*, Autumn 1969) it was incorrectly stated that the Safety Services Division of Central Headquarters was responsible for design and method in engineering matters. The author's original manuscript made it clear that this responsibility remains with the relevant THQ or PHQ group controlling the work in question.

Telecommunications Statistics

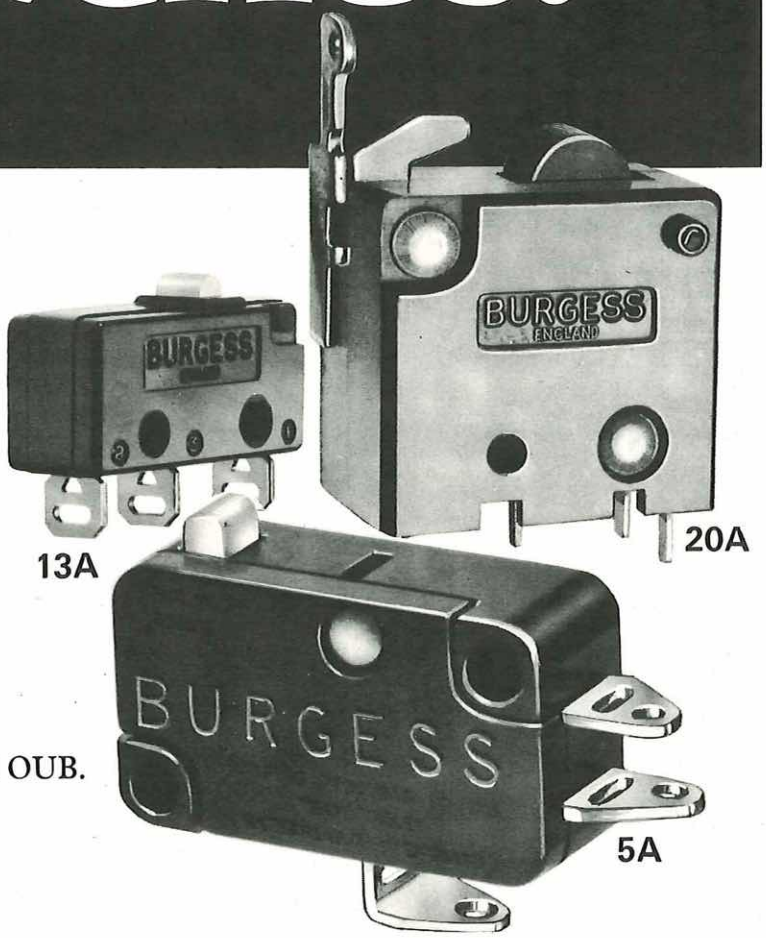
(Figures rounded to nearest thousand)

	Quarter ended June, 1969	Quarter ended March, 1969	Quarter ended June, 1968
TELEGRAPH SERVICE			
Inland telegrams (including Press, Service and Irish Republic)	2,088,000	1,883,000	2,034,000
Greetings telegrams	584,000	469,000	503,000
Overseas telegrams:			
Originating U.K. messages	1,834,000	1,481,000†	1,762,000
Terminating U.K. messages	1,709,000	1,456,000†	1,795,000
Transit messages	1,604,000	1,266,000†	1,528,000
TELEPHONE SERVICE			
Inland			
Net demand	236,000	241,000	174,000
Connections supplied	235,000	240,000	181,000
Outstanding applications	228,000	224,000	234,000
Total working connections	8,017,000	7,868,000	7,483,000
Shared service connections (Bus. and Res.)	1,461,000	1,442,000	1,404,000
Total effective inland trunk calls	320,354,000	311,697,000	282,232,000*
Effective cheap rate trunk calls	77,021,000	69,581,000	63,021,000*
Overseas			
European: Outward	3,351,000	3,152,000	2,856,000
Extra-European: Outward	363,000	331,000	275,000
TELEX SERVICE			
Inland			
Total working lines	27,000	26,000	23,000
Metered units (incl. Service)	65,722,000	77,146,000	58,709,000
Manual calls from automatic exchanges (incl. Service and Irish Republic)	35,000	34,000	29,000
Overseas			
Originating (U.K. and Irish Republic)	4,659,000	4,604,000	4,096,000

*Amended figures
†Strike action 2 weeks in January

Burgess reliable micro switches.

Approved Burgess Micro Switches and Micro Switch assemblies include P O ref 5A, 5A-3, 5A-4, 13A, 13A-2, 16A, 16A-1, 19A, 19A-1, Gravity Switches 20A, 20B, 20C.



BURGESS

Burgess Micro Switch Company Limited,
Dukes Way, Team Valley, Gateshead NE11 OUB.
Telephone 0632—877171. Telex 53229.
London Office: Eastbury House,
Albert Embankment, SE1.
Telephone 01 735 7871. Telex 25553.

INDEX TO VOLUME 21
Spring 1969 to Winter 1969

ALPHABETICAL INDEX

GROUP INDEX

Technical articles of a page length or over appearing in Telecommunications Journal are also indexed in the British Technology Index seven or eight weeks after publication in the Journal.

It's really a phone extension

Most people know that live TV coverage of the moon landing came to Europe via the Post Office Station at Goonhilly.

But TV spectaculars are only the tip of the iceberg at Goonhilly. Those great dish-shaped aerials are being used by Post Office Telecommunications primarily for long-distance phone calls around the world.

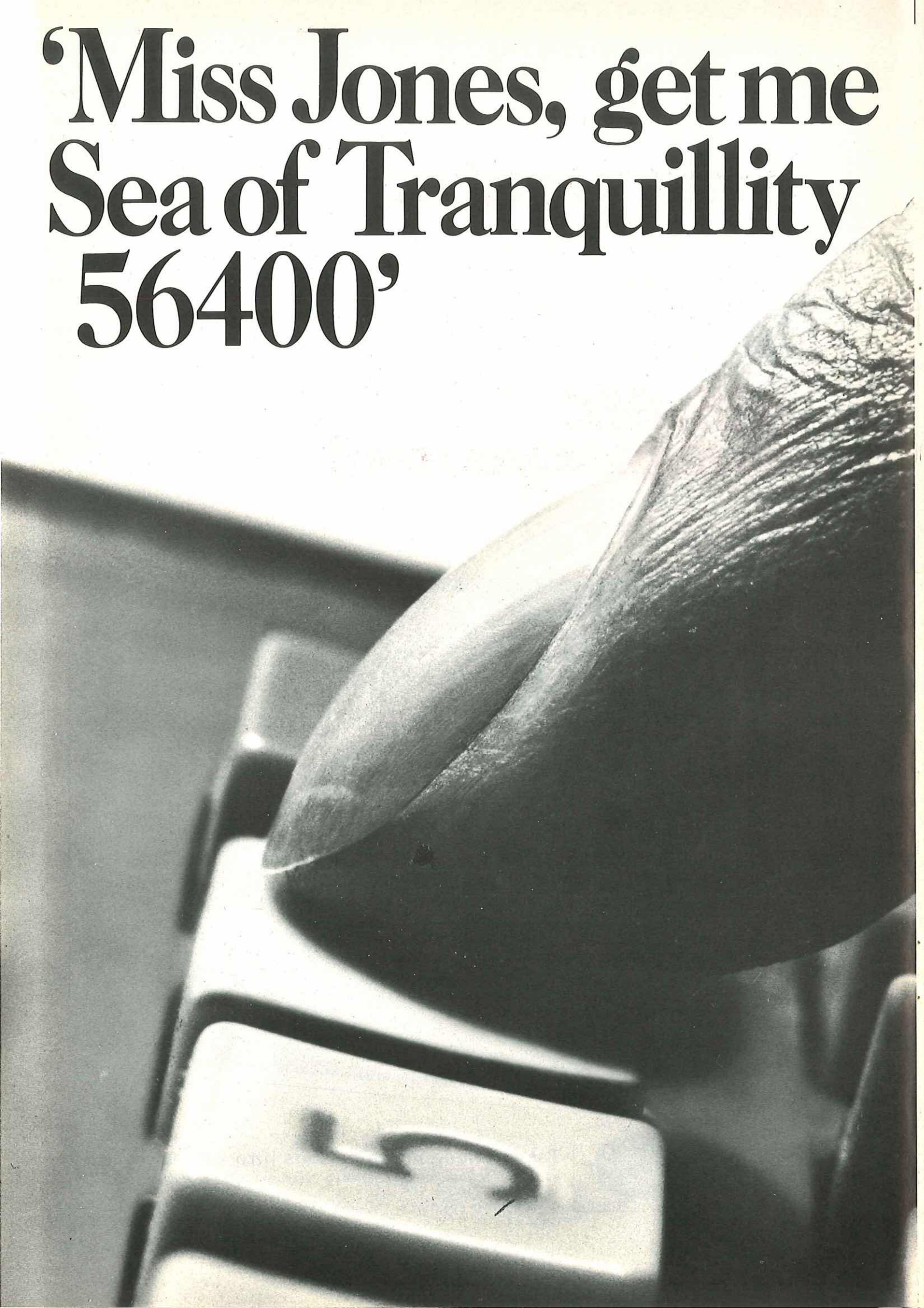
Within a year well over a dozen countries will be reached by satellite links.

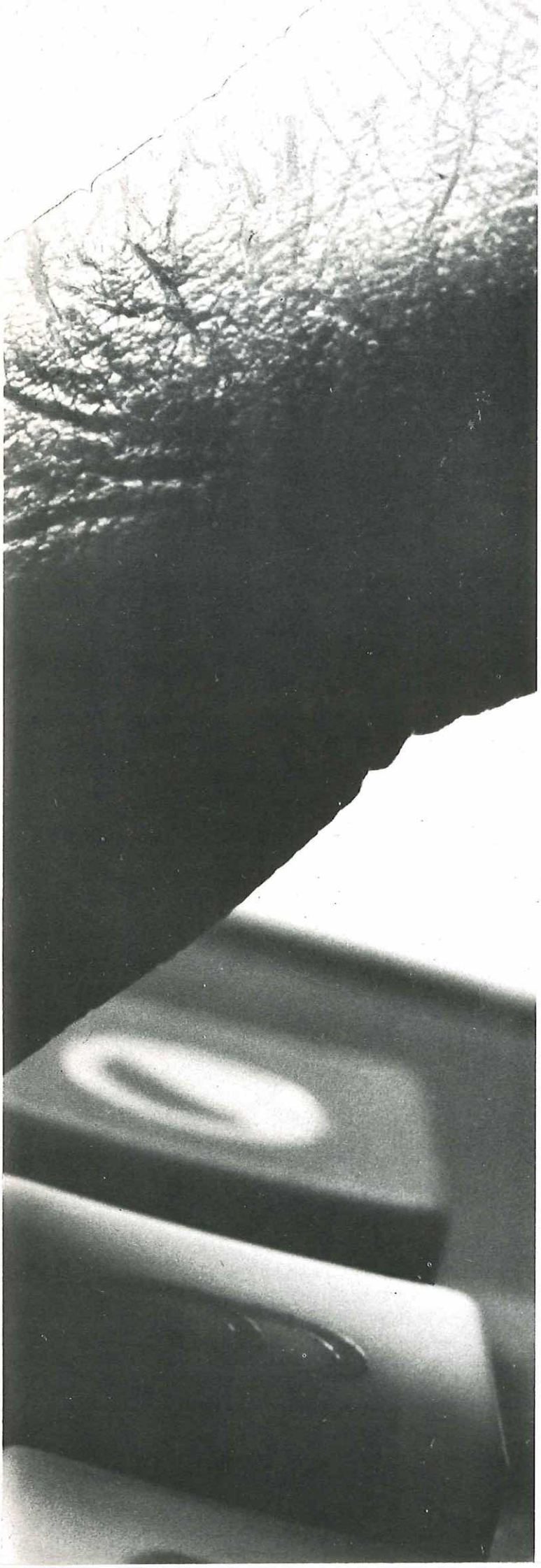
Meantime, Post Office Telecommunications will be bringing you the World Cup live from Mexico. And getting on with the bread-and-butter job of keeping Britain in touch with the world by phone.

The phone service is moving forward

POST OFFICE TELECOMMUNICATIONS

'Miss Jones, get me Sea of Tranquillity 56400'





In this age of all-digit dialling codes, 'Sea of Tranquillity' is unlikely, regrettably, to prefix our man in the Moon's telephone number.

But the ability to supply him with whatever voice, vision or data links he may need is not in doubt.

The techniques exist, anticipating the demand, and many were originated by Plessey.

No active planning of extra-terrestial systems at present, but we are developing better ways of transmitting and switching messages around the world:

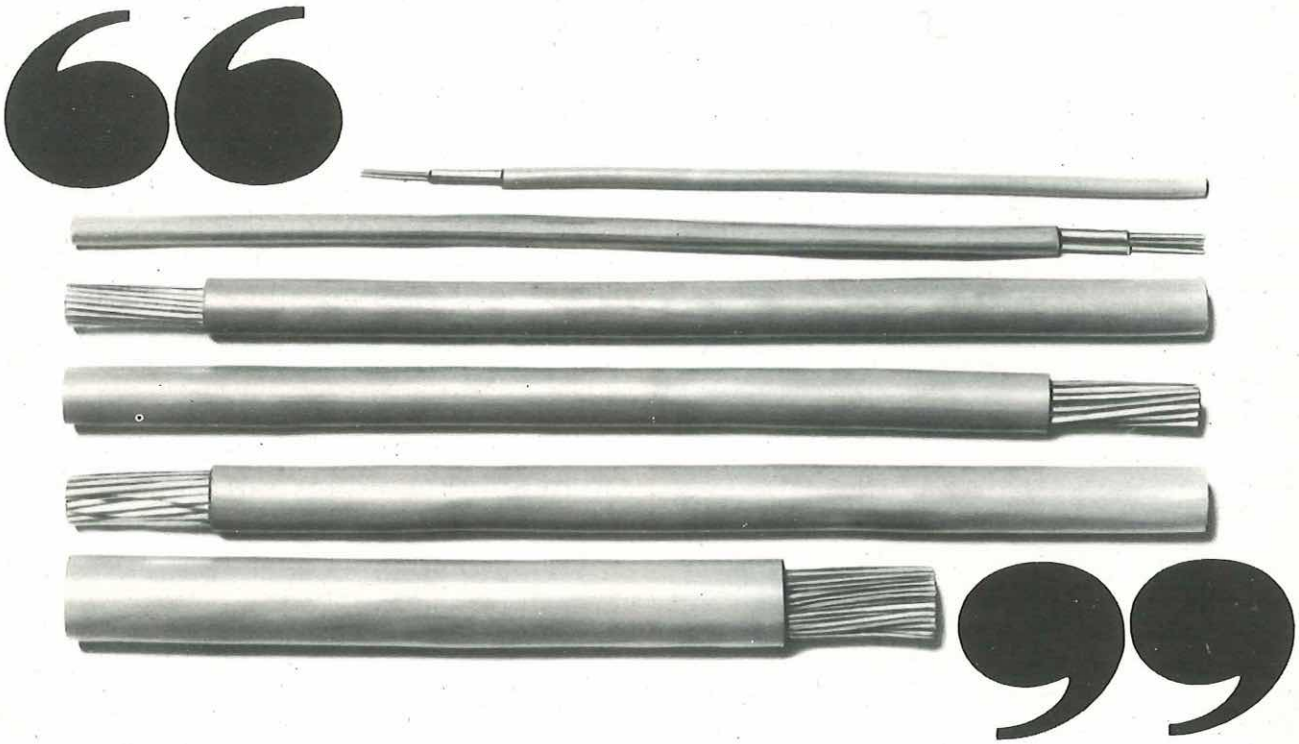
Electronics for speed, reliability and versatility. Computer technology for adaptable switching and facilities. Multi-access satellite systems for international links. Data handling to use circuits to advantage.

Plessey has an extraordinary record of innovation, as befits the largest telecommunications manufacturer in the Commonwealth, but the needs of to-day as well as of tomorrow are the real criteria. Plessey is already heavily involved in the 1970's. Which is why Plessey is a major international force in telecommunications.

Please write for further information on Plessey advanced systems for telecommunications.

The Plessey Company Limited
Telecommunications Group, Edge Lane,
Liverpool L7 9NW, England
Telephone: 051-228 4830 Telex: 62267

PLESSEY
Telecommunications



"PIRELLI GENERAL"

and the power of speech

Internal telephone communication systems call for the same degree of reliability as for national networks. Pirelli General manufactures a range of multipair and multi-way internal telephone cables which are stocked for immediate delivery.
To reduce cross-talk in the multipair construction the pairs are twisted and laid-up with varying lays. Each cable has a distinct colour indentification scheme for the cores or pairs which facilitates quick termination, and a Terylene ripper cord assists in quick removal of the PVC sheath. For further details ring Southampton 20381 or ask for Publication RT508.

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P8577

High Brightness Battery Portable Oscilloscopes

DYNAMCO'S 72 Series

Dynamco's 72 Scope Features

- **AC.DC or Battery**
- **DC to 15MHz**
- **Stable Trigger**
- **All Solid State**
- **Plug-on X & Y Units**
- **Single or Dual Trace**
- **Easy to use**
- **Weighs under 18 lbs. and occupies less than 0.4 cubic feet.**
- **And the display unit may be used separately for monitor purposes.**

See for yourself — ring Chertsey 2636 and ask for Barrie Newman.

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World Wide Sales & Service

DYNAMCO

cut line costs

with Plessey Digital Communications Multiplexers and Modems

Instead of using more and more long-distance telegraph circuits to meet your ever increasing data transmission and telegraph loads, you can drastically reduce line costs by using a Plessey Digital Communications Multiplexer system. Digital multiplexing techniques derive more than four times the number of start/stop telegraph circuits from one telephone circuit compared with conventional FDM channelling systems.

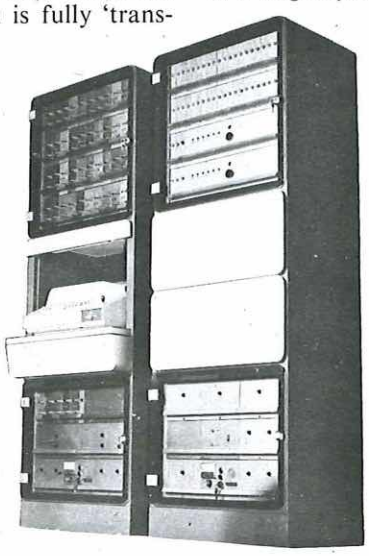
The DCM 48 is a Time Division Multiplexer which can handle mixed telegraph channel speeds and which transmits over the 'main highway' at 1 200, 2 400, 3 600 or 4 800 bits per second. The system is fully 'transparent', except where used in conjunction with a message concentrator or message switching computer.

Plessey modems are currently available at speeds up to 3 600 bits/s.
The number of low speed channels depends upon:—
(*a*) The speed of the low speed channels
(*b*) The character format of the low speed channels
(*c*) The speed of the high speed channel.
Mixed low speed channel speeds can be accepted.

High Speed Channel	50 baud/7.5 unit code	75 baud/7.5 unit code	110 baud/11 unit code	200 baud/11 unit code
1 200 bits/s	32	20	12	5
2 400 bits/s	68	44	27	13
3 600 bits/s	103	68	42	22
4 800 bits/s	138	92	56	30

The system is self-synchronising, and synchronisation signals are error protected. All internal power supplies are duplicated with automatic changeover. In-built spare channel units and scanners can be changed by unskilled staff.

M2400/3600 is a Plessey octonary phase modulated modem, designed for transmission speeds of 2 400 or 3 600 bits per second on a single speech circuit to CCITT M89 recommendations (typically GPO Tariff T), and can be used in conjunction with the DCM48.



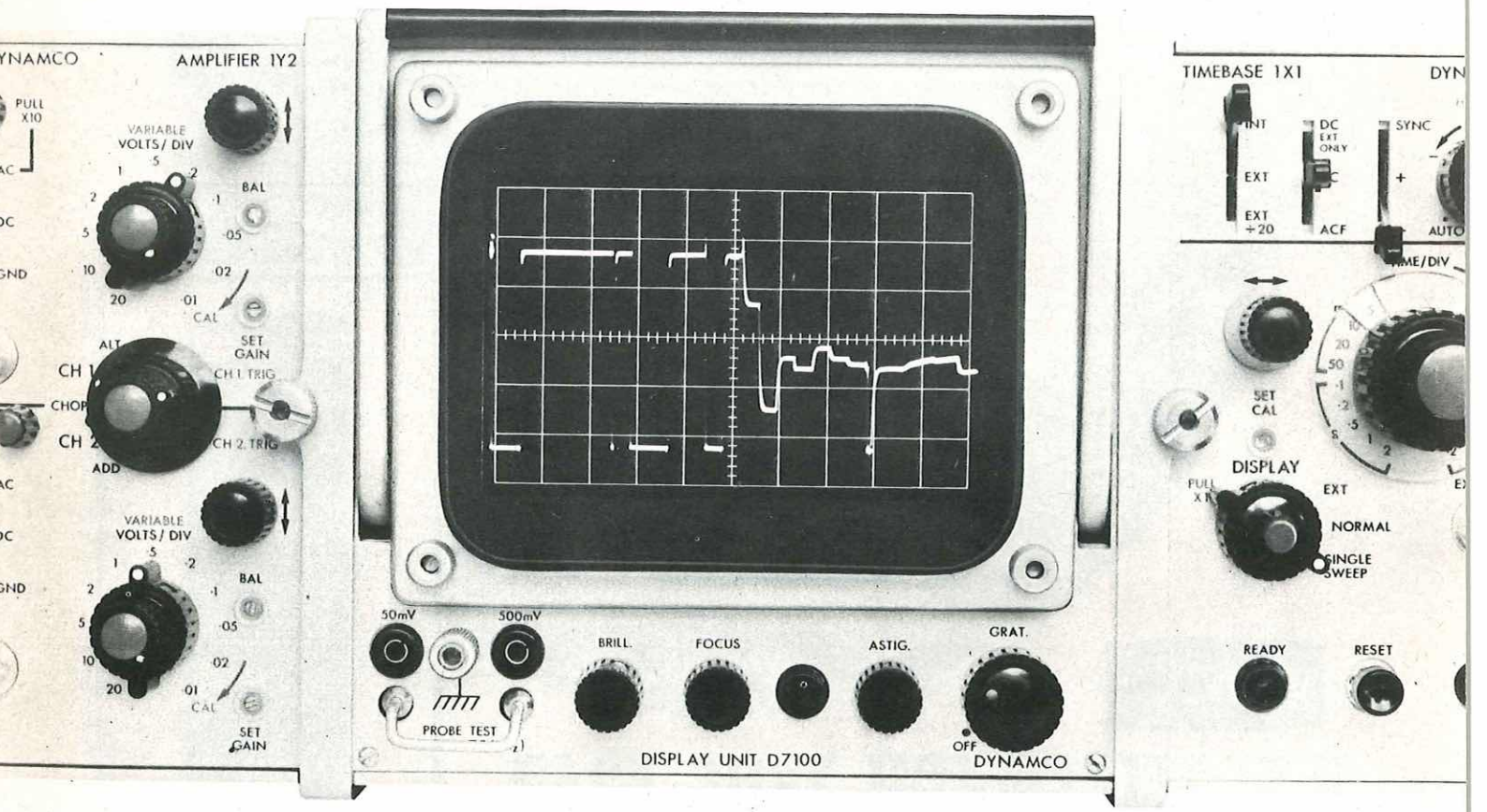
Plessey Electronics

The Plessey Company Limited,
Automation Divisions,
Sopers Lane, Poole, Dorset, BH17 7ER
England.
Telephone: Poole 5161. Telex: 41272

PE(A)7

The Post Office Type 13A

DYNAMCO'S 71 Scopes



The 71 series are a range of professional scopes with plug-in X and Y units featuring:

- **10KV EHT for high brightness displays.**
- **Full 10cm x 6cm display area.**
- **Wide range of X and Y plug-in units 30MHz single and dual trace, wide range and sweep delay timebases, etc.**
- **Bench, rack mounting and portable.**
- **Practical control layout - easy to use.**
- **Suitcase proportions and low weight for portability.**

The 71 series have more plug-in advantages, and more display advantages than any other scopes in their price range.

See for yourself — ring Chertsey 2636 and ask for Barrie Newman.

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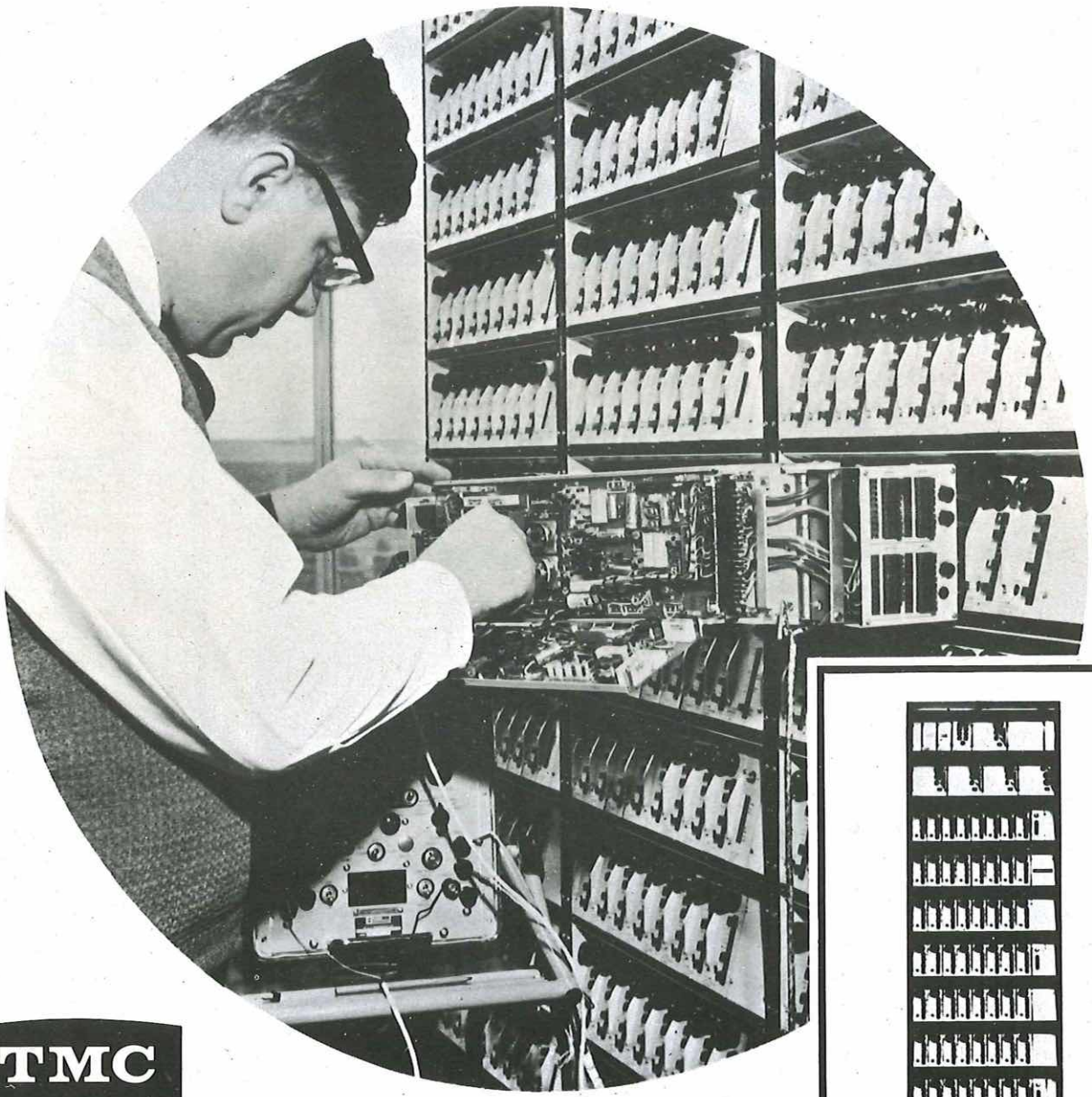

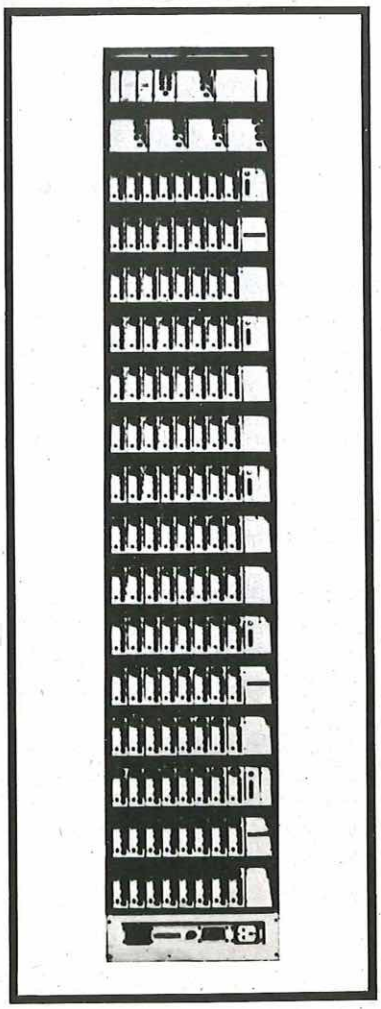

TMC

V.F. TELEGRAPH TYPE T24P

The P.O. International Telegraph Transmission Centre at St. Botolph's, London supplies a vital communications service by providing direct teleprinter links to all parts of the world. Current T.M.C. installation contracts provide 4,000 much needed duplex channels and the total will exceed 6,000 by 1971. This is but one of many P.O. stations in towns and cities throughout the U.K. where steadily increasing numbers of T.M.C. 24 Channel VF Telegraph equipments are being installed. The use of only one stage of modulation permits high and low speed telegraph circuits on one system: channel cards of 50/85 and 100/110 bauds being available.

This is another tribute to the already world wide reputation of T.M.C. Transmission Equipment.

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RESEARCH COMMUNICATIONS

FET PREAMPLIFIERS

Signal frequency:	As specified in the range 1 to 300 MHz.
Bandwidth:	15% of signal frequency max. @—3 dB.
Gain:	max. 45 dB. @ 250 MHz. 60 dB. @ 150 MHz. 85 dB. @ 50 MHz. 100 dB. @ 10 MHz.
Gain control range:	30 dB. manual or external A.G.C.
Noise Factor:	1.0 dB. @ 150 MHz. 1.5 dB. @ 200 MHz. 2.0 dB. @ 250 MHz.
Impedance:	52 or 75 ohms or as specified.
Connectors:	BNC, N, SO239, L.604, or as specified.
Power:	12v. @ 12 ma. DC. Positive, negative, or isolated earth. Supplied via output feeder or direct to unit.
Size:	5" x 1" x 1".
Weight:	11 oz.
Cct:	Selected Texas T1S88A FETs in neutralised cascode. RCA 3N140 dual gate MOSFET gain control. RCA 3N140 output stage. Pot core bandpass couplers. Full-wave silicon diodes across input for transient protection. Polarity reversal protection diode. 12v. zener voltage transient clipper across supply line.

FET CRYSTAL CONTROLLED FREQUENCY-CONVERTERS

Input frequency:	As specified in the range 1 to 300 MHz.
Output frequency:	As specified in the range 100 KHz. to 300 MHz.
Cct:	Selected Texas T1S88A FETs in neutralised cascode RF stage. RCA 3N141 dual gate MOSFET mixer. RCA 3N140 dual gate MOSFET 2nd mixer/output and gain control. Cathodeon HC18/U sub-miniature crystal. RCA 40602 dual gate MOSFET crystal oscillator and multiplier. High Q break in mixer injection gate.

Other details as FET preamplifier.

RECEIVERS

1 to 300 MHz. Crystal-controlled. AM or FM.

Up to 5 channels within 15% of centre signal frequency.

Output:	1 watt into 8 ohms or as specified.
Cct:	As frequency converter. I.F. Mullard TAD110 Linear IC. A.F. Mullard TAA300 Linear IC.
Power:	12v. @ 35 ma. DC. Positive, negative, or isolated earth.
Size:	$4\frac{1}{2}$" x $2\frac{1}{2}$" x $1\frac{1}{4}$".
Weight:	12 oz.

RESEARCH COMMUNICATIONS
PEEL HOUSE, PORTERS LANE, OSPRINGE, FAVERSHAM. KENT

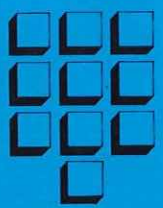
Telephone: Faversham 2064

Mr. P. H. STRUDWICK for further information

The Post Office Telecommunications Journal is printed by BKT Printers Ltd., London and Tonbridge, and is published quarterly in December, March, June and September by the Post Office.

the maintenance eliminators

You'll be hearing a lot about the Cross Bar in future. It's a beautifully simple and ingenious switch system by Swedish Ericsson which has already enjoyed years of success all over the world. As any service engineer knows, one of the most important features in any system is the ease of maintenance: the Ericsson Cross Bar Switch System is practically maintenance free and that's why Cross Bar has been adopted for use in remote areas where maintenance can be tricky and places where there are few skilled engineers available.
It's quiet, efficient and fast. It's neat, tidy and space-saving. It's used on PAX as well as PABX. Swedish Ericsson would be pleased to demonstrate Cross Bar to anyone interested or to send along technical literature.



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